SCHOOL

OF

BIOTECHNOLOGY

Karunya University

SUBJECTS (Biochemistry)

Code	Subject Name	Credit
BC201	Biochemistry	4:0:0
BC202	Biochemistry Lab	0:0:2
BC203	Bioorganic chemistry	4:0:0
BC204	Food Biochemistry & Nutrition	4:0:0
BC205	Food Biochemistry lab	0:0:2
BC206	Instrumental Methods of Analysis	4:0:0
BC207	Instrumental Methods of Analysis lab	0:0:2
BC208	Biophysics	4:0:0

BC201 BIOCHEMISTRY

Credit : 4:0:0 **Marks (40+60)**

Unit - I : Structure and Properties of Carbohydrates and Lipids

Structure and properties of mono, di, oligo and polysaccharides, complex carbohydrates. Structure and properties of fatty acids, phospholipids, sphingolipids, glycolipids and steroids.

Unit – II : Structure and Properties of Proteins and Nucleic Acids

Structure and properties of amino acids, modified amino acids, peptides, proteins and conjugated proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, ribonucleic acids, deoxy ribonucleic acids, nucleoprotein complexes.

Unit-III : Metabolism of Lipids, Proteins and Nucleic Acids

Biodegradation of proteins and nucleic acids. Biosynthesis and biodegradation of amino acids, fatty acids, cholesterol, purines and pyrimidines

Unit – IV : Intermediary Metabolism and Bioenergetics

Carbohydrate Metabolism: Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate pathway - Urea Cycle – Overview of intermediary metabolism: Interconnections and regulation of metabolic pathways. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle.

Unit – V : Structure Function Relationship

Structural and functional relationships in complex carbohydrates, conjugated proteins and conjugated nucleic acids.

Text book:

1. Lehninger, AL, Nelson DL and Cox MM, Principles of Biochemistry

References:

1. Lubert Stryer, *Biochemistry*, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, *Biochemistry*, 2nd Edition, John Wiley & Sons Inc., 1995.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., *Harper's Biochemistry*, Prentice Hall International.

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BC202 BIOCHEMISTRY LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BC203 BIO-ORGANIC CHEMISTRY

Credit : 4:0:0 **Marks (40+60)**

Unit – I Concepts in Organic Chemistry

Stereochemistry – R,S notation – re-si faces – e,z isomerism- conformers- ethane – cyclopentane - reactivates- mechanisms of sn1 sn2 reactions, e1 e2 reactions – ester formation and hydrolysis, reaction rates - Hammond's postulate – h/d effects. Catalysis – general acid – base and covalent catalysis.

Unit - II Stereochemistry of Enzymatic Reactions

Stereospecific enzymatic reactions – fumarase catalysed reactions – NAD dependent oxidation and reduction reactions - stereochemistry of nucleophilic reactions – chiral methyl group – chiral phosphate.

UNIT – III Case Studies of Enzyme Structure and Mechanism

The dehydrogenases – the proteases – ribonucleases – lysozyme- stability of proteins – stability – activity tradeoff.

UNIT – IV Kinetics of Protein Folding

Basic methods – two state kinetics – multistate kinetics – transition states in protein folding – 1h/2h exchange methods – folding of peptides.

UNIT – V Folding Pathways & Energy Landscapes

Folding of ci2 – nucleation condensation mechanism – folding of barnase – time resolution – insights from theory – optimization of folding rates – molecular chaperones.

Text book

1. R. Fersht, W.H. Freeman, *Structure and Mechanism in Protein Science* : *A Guide To Enzyme Catalysis and Protein Folding*;,1999.

Reference books

1. H. Dugas, *Bioorganic Chemistry* ; Springer Verlag, 1999.
2. Fisher J and Arnold JRP *Chemistry for Biologists”,* VIVA Books Pvt Ltd, New Delhi 2001.

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BC204 FOOD BIOCHEMISTRY AND NUTRITION

Credit : 4:0:0 **Marks (40+60)**

Unit I

Glycolysis – Embden Meyerhof Pathway (EMP), Pentose phosphate shunt, TCA cycle, gluconeogenesis, urea cycle, inter connections of pathways, metabolic regulation, Bioenergetics – Electron transport chain, respiratory chain ATP cycle, energy rich compounds.

Unit II

Biosyntheses and degradation of fatty acids, and cholesterol - Biosyntheses and degradation of amino acids, peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids.

Unit III

Basic concept of nutrition – Importance of nutrition and dietetics - Assessment of nutritional status – energy value of carbohydrates, proteins and fats – determination of energy value – balanced diet – Recommended dietary intake – Acceptable dietary intake – Protein efficiency ratio – Net protein utilisation and their determinations – Malnutrition and its problems – Nutrient supplementation – fortification - Nutritional labeling and its importance - Effect of processing on protein quality, essential amino acids - Digestibility, carbohydrates in food and dietary fibre

Unit IV

Inborn errors of carbohydrate, protein and fat metabolisms - Nutrition and disorders associated with organs such as liver and kidney - Naturally occurring anti-nutritional factors – Cyanogens, lectins, enzyme inhibitors, phytoallexins, phytates

Unit V

Nutrition for specialized purposes – Paediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods

Ageing –Theories of ageing – Nutrition and ageing – Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, Alzheimer's disease

Text / Reference Books:

1. Lehninger A.L, Nelson D.L., M.M. Cox, *Principles of Biochemistry*, CBS Publications, 1993.
2. Voet D, Voet G, *Biochemistry*, Second Edition, John Wiley and Sons, 1994.
3. Stryer L, *Biochemistry*, Fouth edition, 1994.
4. *Food and Nutrition*, Wahlquist M L, 1997
5. *Principles of Human Nutrition* – Second Edition, Edited by Martin Eastwood, Blackwell Publishing
6. *Functional foods and Nutraceuticals in Cancer Prevention*, Edited by Ronald Ross Watson

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BC205 FOOD BIOCHEMISTRY LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BC206 INSTRUMENTAL METHODS OF ANALYSIS

Credit : 4:0:0 **Marks (40+60)**

UNIT I Buffer Solutions

Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H_2 electrode and glass electrode.

UNIT II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer

Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer.

UNIT III Chromatography and Electrophoresis

Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC.

Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis, isotachophoresis, supporting materials-paper, starch, agarose, polyacrylamide.

UNIT IV Radio active techniques

Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Autoradiography, Applications in Medicine & Diagnosis

UNIT V Thermo Analytical Techniques

Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC)

Text Book

1. Willard and Merrit, *Instrumental Methods and Analysis*. VI Edition, CBS Publishers & Distributors.

Reference Books:

1. Ewing GW, *Instrumental methods of Chemical Analysis*, McGraw Hill Book Company, 1989.
2. Braun. H, *Introduction to Chemical Analysis*, McGraw Hill, 1987.

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BC207 INSTRUMENTAL METHODS OF ANALYSIS LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BC208 BIOPHYSICS

Credit : 4:0:0 **Marks (40+60)**

UNIT I Introduction

Levels of structures in Biological macromolecules. Central questions in biophysics, basic strategies in biophysics.

UNIT II Conformational Analysis

Forces that determine protein and nucleic acid structure, basic problems, polypeptide chains geometrics, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions and water structures ionic interactions, disulphide bonds.

UNIT III Structural Analysis of Macromolecules

Prediction of proteins structure, nucleic acids, general characteristics of nucleic acid structure, geometrics, glycosidic bond rotational isomers and those puckering backbone rotational isomers and ribose puckering forces stabilising ordered forms, base pairing, base stacking tertiary structure of nucleic acids.

UNIT IV Kinetics of Ligand Interaction

Biochemical Kinetics studies, unimolecular reactions, simple biomolecular multiple intermediates, steady state kinetics, catalytic efficiency, relaxation spectrometry, ribonuclease as an example.

UNIT V Techniques for the Study of Biological Structure & Function

Size and shape of macromolecules, methods of direct visualisation, macromolecules as hydrodynamic particles, macromolecular diffusion, ultracentrifugation, viscometry

X-ray crystallography – X–ray diffraction, determination of molecular structures ,electron microscopy, neutron scattering, light scattering.

Text Book

1. Cantor R., Schimmel P.R., *Biophysical Chemistry*, Vol. I, II, W.H. Freeman & Co., 1985.

Reference Book

1. Daniel. M, *Basic Biophysics for Biologists*, 1998.

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SUBJECTS (Microbiology)

Code	Subject Name	Credit
MB101	Introduction to Biology	3:0:0
MB102	Introduction to Biology Lab	0:0:1
MB201	Cell Biology	4:0:0
MB202	Cell Biology Lab	0:0:1
MB203	Microbiology	4:0:0
MB204	Microbiology lab	0:0:1
MB205	Molecular Biology	4:0:0
MB206	Molecular Biology lab	0:0:1
MB207	Food Microbiology	4:0:0
MB208	Food microbiology lab	0:0:2

MB101 INTRODUCTION TO BIOLOGY

Credit : 3:0:0 **Marks (40+60)**

Unit – 1: Biodiversity

Biodiversity in living organisms–systems of classification–taxonomic systems-nomenclature methods.

Principle and working methodology of compound microscope-structure of prokaryotic and eukaryotic cell- cell division.

Salient features of fungi and algae; types and structure of both plant and animal viruses–diseases caused by them– life cycle of phage and HIV; classification and reproduction mode of bacteria – their beneficial and harmful effects.

Unit II - Anatomy of plants

Tissue and tissue systems – anatomy of Roots: monocot –dicot; Stems: monocot –dicot; dicot leaf.

Unit III - Anatomy of animals

Digestive system – Structure of tongue, teeth, pharynx, oesophagus, stomach, small intestines and Liver

Respiratory system – structure of nasal cavity, pharynx, trachea and lungs

Circulatory system – Components of circulatory system – structure of blood vessels – Types of blood vessels – Structure of heart

Urinary system – Structure of kidneys and nephron

Reproductive system – Brief description of the male and female reproductive organs

Unit – IV : Physiology of plant

Cell as a physiological unit-absorption, transport and transpiration of water; Translocation of minerals and solutes; Photosynthesis : photophosphorylation- C_4 and C_3 pathway–Photorespiration (C_2 cycle); mode of nutrition; chemosynthesis; Plant growth; Reproduction in angiosperms-Germination of seeds.

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Unit V- Animal and Human Physiology

Digestion – process, Absorption and assimilation. Respiration – Process, mechanism of breathing, gaseous exchange in alveoli, Regulation of respiration. Circulation – Functioning of human heart, Origin and conduction of heart beat, Cardiac cycle. Blood – composition, blood cells. Excretion – mechanism of urine formation

Chemical co-ordination systems

Text Books:

1. Biology (Zoology), Higher Secondary First and Second year, Tamilnadu Text Book Coporation, First edition, 2004 & 2005.
2. Biology (Botany), H.S.C- First and Second year Tamilnadu Text Book Coporation, First edition, 2004 & 2005.

MB102 INTRODUCTION TO BIOLOGY LAB

Credit : 0:0:1 **Marks (50+50)**

6 experiments will be notified by the HOD from time to time

MB201 CELL BIOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Structure and Function of the Cell and Its Organelles

Eukaryotic and prokaryotic cells: principles of membrane organization - Micelles, membrane proteins, cytoskeletal proteins, contractile proteins – actin & myosin, extra cellular matrix. Cell division: mitosis & meiosis, cell cycle, molecules that control cell cycle.

UNIT – II Transport Across Cell Membranes

Passive & active transport, permeases, sodium potassium pump, Ca^{2+} ATPase pump, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport, symport, antiport, trans-membrane potential coupled ATP generation, ion-selective gated channel against neuronal cell membrane, Transport into prokaryotic cells, endocytosis and exocytosis. Entry of virus and toxins into cells.

UNIT – III Receptors and Models of Extra Cellular Signalling

Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, quantitation and characterisation of receptors.

UNIT – IV Signal Transduction

Signal amplification, different models of signal amplifications, role of cyclic AMP, cyclic GMP and G proteins in signal transduction, biosynthesis of inositol tri phosphates and their role as messengers, calcium ion flux and its role in cell signaling, phosphorylation and regulation of protein kinases in signalling, serine – threonine kinases in signalling.

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UNIT – V Cell Culture

Techniques for the propagation of eukaryotic and prokaryotic cells. Cell line: generation of cell lines, maintenance of stock cells, characterization of cells, immunochemistry, morphological analysis, techniques in cell culture, explant cultures, primary cultures, contamination, differentiation, three dimensional cultures, role of matrix in cell growth.

Text Books:

1. Darnell J, Lodish H, Baltimore D, *Molecular Cell Biology*, W.H.Freeman;
2. Ian Freshney R, *Culture of Animal Cells*., 2nd edition, Alan R. Liss, Inc., New York.

References:

1. Kimball T.W., *Cell Biology*, Wesley Publishers;
2. De Robertis & De Robertis, *Cell Biology*;
3. James D.Watson, *Molecular Biology of the Cell.*

MB202 CELL BIOLOGY LAB

Credit : 0:0:1 **Marks (50+50)**

6 experiments will be notified by the HOD from time to time

MB203 MICROBIOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT – II Microbes-Structure and Multiplication

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

UNIT – III Microbial Nutrition, Growth And Metabolism

Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics, utilization of energy for biosynthesis of important molecules.

UNIT – IV Control of Microorganisms

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

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UNIT – V Industrial and Environmental Microbiology

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, Vit.B_{12}; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers rhizobia, cyanobacteria, mycorrhizae (AMFungi) and biopesticides; microorganisms and pollution control; biosensors.

Text Book

1. Pelczar MJ, Chan ECS And Krein NR, *Microbiology*, Tata McGraw Hill Edition, New Delhi, India.
2. Prasad B.N., *"A Text Book of Biotechnology"*, (2003) Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.

References

1. Talaron K, Talaron A, *Casita, Pelczar and Reid. Foundations in Microbiology*, W.C.Brown Publishers, 1993.
2. Prescott LM, Harley JP, Klein DA, *Microbiology*, 3rd Edition, Wm. C. Brown Publishers, 1996.
3. Prasad B.N., *"Biotechnology in Sustainable Biodiversity and Food Security"* (2003), Oxford & IBH, New Delhi.

MB204 MICROBIOLOGY LAB

Credit : 0:0:1 **Marks (50+50)**

6 experiments will be notified by the HOD from time to time

MB205 MOLECULAR BIOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Classical Genetics

Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

UNIT – II DNA Replication

Replication in prokaryotes and eukaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes, DNA repair.

UNIT – III Transcription

Prokaryotic and eukaryotic transcription, features of promoters and enhancers, transcription factors, inhibitors, post-transcriptional modification - RNA splicing, ribozyme. RNA editing.

UNIT – IV Translation

Elucidation of genetic code, process of translation in prokaryotes and eukaryotes, suppressor mutation, post-translational modifications, inhibitors of protein synthesis.

UNIT – V Regulation of Gene Expression

Regulation at various stages of gene expression in eukaryotes and prokaryotes - *Lac* and *trp* operons.

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Text Books

1. David Friefelder, *Molecular Biology*, Narosa Publ. House. 1999
2. Gardner / Simmons / Snustad, *Principles of Genetics*, Eighth Edition, John Wiley

Reference books

1. Benjamin Lewin, *Gene VII*, Oxford University Press. 2000
2. Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM,. *Molecular Biology of the Gene*. 1987

MB206 MOLECULAR BIOLOGY LAB

Credit : 0:0:1 **Marks (50+50)**

6 experiments will be notified by the HOD from time to time

MB207 FOOD MICROBIOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I

Micro organisms associated with foods: Bacteria – Gram negative aerobic Rods, Gram negative facultative anaerobic Rods- Gram Negative anaerobic rods - Endospore formers Irregular non-sporing gram positive rods their role in food spoilage

Molds, Definitions - Fungi as Food, importance of molds, Molds in the category of Zygomycetes, Deuteromycetes etc.: Viruses; Definitions, Intestinal viruses, Bacterial viruses and Fungal Viruses - Factors affecting growth of bacteria, mold and Yeast – nutrition, temperature, pH conditions, Carbon and Nitrogen Sources, Moisture and water activity; Redox potential, antimicrobial barriers and constituents

Unit II

Sources of microorganisms – Soil, water, Plants and of animal origin, Useful microorganisms – Lactic Acid Bacteria, Yeast, mold and fungi. Estimating number of microorganisms, sampling, sample size, aseptic collection of samples, total cell counts and viable cell counts, plate counters. Alternative methods – Dye-reduction tests, electrical methods, ATP determination – Rapid methods for the detection of specific organisms and toxins – Immunological methods and DNA/RNA methodology

Microbiological quality control and HACCP

Unit III

Heat processing – Pasteurisation and appertization – determination of D and z values – heat sensitivity of micro-organisms – spoilage of canned foods – aseptic packaging

Irradiation – Brief account of microwave, UV and ionizing radiation

High pressure processing – Pascalisation

Low-temperature storage – Chilling and freezing

Use of chemical preservatives, Natural food preservatives

Brief overview of Modified storage packaging

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Unit IV
Microbiology of Food commodities
Cereals, Pulses, Nuts and Oilseeds, Fruits and Fruit products, Vegetables and Vegetable products

Unit V
Food borne pathogens
Aeromonas hydrophila, Bacillus cereus, Brucella, Camphylobacter, Clostridium botulinum, Escherichia coli, Salmonella, Staphylococcus aureus, Scombrotic fish poisoning, Hepatitis A and B, Gastroenteritis viruses, Spongiform encephaolpathies

Text Books

1. W.C.Frazier: *Food Microbiology (II edition or later)* Mcgraw Hill Book Company, New York (1968)
2. M.R. Adams and M.O. Moss, *Food Microbiology*, Second Edition, Panima Publishing corporation, New Delhi. Third reprint 2004

References:

1. Gustavo F Gutierrez-Lopez, Gustavo V Barbosa-Canovas *Food Science and Food Biotechnology:* CRC Press 2003
2. Bibek Ray: *Fundamental Food Microbiology*, (Third Edition) CRC Press December 2003

MB208 FOOD MICROBIOLOGY LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

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SUBJECTS (Chemical Engineering)

Code	Subject Name	Credit
CL201	Chemical Thermodynamics & Bio-thermodynamics	4:0:0
CL202	Principles of Chemical Engineering	4:0:0
CL203	Chemical Engineering Lab	0:0:2
CL204	Unit Operations	4:0:0
CL205	Chemical Reaction Engineering	4:0:0
CL206	Mass Transfer Operations	4:0:0
CL207	Process Engineering Calculations	4:0:0
CL208	Unit Operations in Food Processing - I	4:0:0
CL209	Heat Transfer and Fluid Flow	4:0:0
CL210	Unit operations in Food Processing – II	4:0:0

CL201 CHEMICAL THERMODYNAMICS AND BIOTHERMODYNAMICS

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Thermodynamic Properties of Fluids
Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT – II Solution Thermodynamics
Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT – III Phase and Chemical Reaction Equilibria
Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria. Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT – IV Thermodynamic Analysis of Processes
Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

UNIT – V Biochemical Thermodynamics
Energetics of metabolic pathways energy coupling (ATP and NADH), stochiometric and energetic analysis of cell growth and product formation-elemental balances, degree of reduction concepts-available –electron balance, yield coefficients, oxygen consumption and heat evolution in aerobic cultures, thermodynamics efficiency of growth.

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Text Books

1. Narayanan K.V. *A Text Book Of Chemical Engineering Thermodynamics*, Prentice Hall India, 2001.

Reference books

1. Sandler S.I. *Chemical And Engineering Thermodynamics*, John Wiley,1989.
2. Smith J.M., Van Ness H.C., Abbot M.M. *Chemical Engineering Thermodynamics*. 6th Edition. McGraw-Hill, 2001.
3. Royels, JA, *Kinetics and Energetics in Biotechnology*, Elseviers, 1983

CL202 PRINCIPLES OF CHEMICAL ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Overview of Process Engineering

Mass and energy conservation; process automation; environment; SI units; conversion factors; applied mathematics for experimental curve fitting; numerical differentiation; integration.

UNIT – II Material Balances

Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; unit operations; recycle and by pass; humidity calculations.

UNIT – III First and Second Laws of Thermodynamics

Energy balances; sensible heat, latent heat; vapour pressure; steady and unsteady state calculations.

UNIT – IV Fluid Mechanics

Fluids; fluid statics and applications in chemical engineering; fluid flow; laminar; turbulent pressure drops; compressible fluid flow concepts; multiphase flow concepts.

UNIT – V Flow Through Packed Columns

Fluidisation; centrifugal and piston pumps; characteristics; compressors; work

Text Books

1. Bhatt B.I., Vora S.M. Stoichiometry,3rd Edition. Tata McGraw-Hill, 1977.
2. McCabe W.L., Smith J.C, Harriot P. *Unit Operations In Chemical Engineering*, 5th Edition. McGraw-Hill Inc., 1993.

Reference books

1. Geankoplis C.J. *Transport Processes And Unit Operations*, Prentice Hall India, 2002.

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CL203 CHEMICAL ENGINEERING LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

CL204 UNIT OPERATIONS

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Mixing and Agitation
Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

UNIT – II Filtration
Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.

UNIT – III Heat Transfer - Conduction
Steady state conduction; combined resistances; unsteady state conduction; lumped heat capacity; extended surfaces; combined conduction and convection.

UNIT - IV Heat Transfer – Convection and Radiation
Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes boiling and condensation. Heat transfer to non-newtonian fluids
Radiation – Basic concepts

UNIT – V Heat Exchangers
Equipments; overall heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy balances.

Text books

1. McCabe W.L., Smith J.C. *Unit Operations In Chemical Engineering*, 5th Edition, Mcgrawhill.1993.

Reference books

1. Incropera F.P. *Fundamentals Of Heat And Mass Transfer*, John Wiley.1998.
2. Geankoplis C.J. *Transport Processes And Unit Operations*, Prentice Hall India.2002.

CL205 CHEMICAL REACTION ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Scope of Chemical Kinetics & Chemical Reaction Engineering
Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

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Unit – II Ideal Reactors
Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT – III Ideal Flow and Non Ideal Flow
RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT – IV Gas-Solid, Gas-Liquid Reactions
Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT – V Fixed Bed and Fluid Bed Reactors
G/l reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

Text Books

1. Levenspiel O. *Chemical Reaction Engineering*, 3rd Edition. John Wiley.1999.

Reference Books

1. Missen R.W., Mims C.A., Saville B.A. *Introduction To Chemical Reaction Engineering And Kinetics*, John Wiley.1999.
2. Fogler H.S. *Elements Of Chemical Reaction Engineering*, Prentice Hall India.2002

CL206 MASS TRANSFER OPERATIONS

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Diffusion and Mass Transfer
Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT – II Gas Liquid Operations
Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT – III Vapour Liquid Operations
V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT – IV Extraction Operations
L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

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UNIT – V Solid Fluid Operations
Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves-Time of Drying; Batch and continuous dryers.

Text Books

1. Coulson and Richardson's *Chemical Engineering*, Vol I & II, Asian Books Pvt Ltd, 1998.

Reference books

1. Treybal R.E., *Mass Transfer Operations*, 3rd edition. Mcgraw Hill, 1981.
2. Geankoplis C.J. *Transport Processes and Unit Operations*, 3rd edition, Prentice Hall of India, 2002.

CL207 PROCESS ENGINEERING CALCULATIONS

Credit : 4:0:0 **Marks (40+60)**

Unit I : Introduction to Food Engineering Calculations:
systems of measurements; review of SI system of measurement; Units and Dimensions, Mole unit, conventions in methods of analysis and measurement, basis, temperature, pressure, chemical equations and stoichiometry

Unit II : Gases, Vapours, Liquids and Solids
Ideal Gas relationships, vapour equilibria for multi-component systems, material balances involving condensation and vaporization.

Unit III : Material Balances
Material balance of food processes involving Dilution, Concentration and Dehydration, Multistage processes and numerical examples

Unit IV : Energy Balances
Concept and units, calculations of enthalpy changes, general balance with or without reactions, heats of solution and mixing: Unsteady state material and energy balances.

Unit V : Kinetics of Chemical Reactions in Foods
Theory of reaction rates, types of reactions, enzymatic reactions, and reaction rate constant, temperature dependence of reaction rates

Text/Reference Books

1. Romeo T.Toledo: *Fundamentals of Food Process Engineering*, Van Nostrand Reinhold, New York (1991)
2. Himmelblau D.M. & J. B.Riggs: *Basic Principles and Calculations in Chemical Engineering :* Prentice Hall International, (7th Edition, 2004)
3. M. Loncin and R. L. Merson: *Food Engineering, Principles and selected applications*: Academic Press, London
4. Stanley E Charm: *The fundamentals of Food engineering, A*VI Publishing company, New York (1981)

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5. J. Clair Batty and Steven L Folkman: *Food Engineering Fundamentals*, John Wiely & sons Publishers, New York

CL208 UNIT OPERATIONS IN FOOD PROCESSING I

Credit : 4:0:0 **Marks (40+60)**

Unit I : Introduction
Basic principles of food processing, Conservation of mass and energy, Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

Unit II : Distillation
Distillation, Steam distillation, applications and equipment. Molecular distillation, theory and examples. Mass transfer phenomenon applied to food systems

Unit III : Evaporation
Needs, basic principles, Calculations, Single and multiple effect evaporation, Heat economy, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit IV : Contact Equilibrium Separation Processes
Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction extraction, with food application examples, Crystallization

Unit V : Super Critical Fluid Extraction
Super critical Fluid State, Properties of Super critical CO_2 , Density, Viscosity, Volatility etc. Supercritical Phase Equilibria, Solubility, Mass transfer operations, SCFE systems and components, Applications; extraction of Fatty acids, Hops, Essential oils and Bio chemicals; Relative advantages, limitations and economics

Text/Reference Books

1. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's *Chemical Engineering* - Vol 2 *Particle Technology and Separation Processes*, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.
2. H.A.Lenigar and W.A.Beverlo: *Food Process Engineering*, D.Reidal Publishing Co, Boston, USA
3. R.L.Earle: *Unit Operations in Food Processing*, (II Edition or later), Pergamen Press, New York
4. Albert Ebarz: *Unit Operations in food Processing*, CRC Press
5. Marcus Karel & Deryl B Lund: *Physical Principles of Food Processing*, Marcel Dekker Inc.
6. H.S. Ramaswamy & M. Markotte: *Food Processing Principles and Applications*, CRC Press Ltd.

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7. Dennis R. Heldman and R. Paul singh: *Food Process Engineering* (II Edition), AVI Publishing Company Inc. (1981)
8. Zacharias B. Maroulis and G. D. Saravacos: *Food Process Design* Marcel Dekker, USA (2003)

CL209 HEAT TRANSFER AND FLUID FLOW

Credit : 4:0:0 **Marks (40+60)**

Unit I : Fluid flow Theory Applications
Fluid statics, pressure dynamics, Bernoullie's equation, Newtonian and non Newtonian fluids, Laminar and Turbulent flow, friction losses in pipes valves and bends, Simple calculations.

Unit II : Flow Measuring Devices
Orificemeter, Venturimeter, Rotameter, Pitot tube, the Nozzle, the Notch or weir, hot wire anemometer

Unit III : Conductive Heat Transfer
Conduction, Equations for heat conduction through a cylinder, sphere
Steady heat conduction in simple geometries – Plane wall, Cylindrical wall with and without heat generation
Transient heat conduction – Lumped capacitance method for bodies of infinite thermal conductivity
Theory of insulation, critical radius of insulation
Overall heat transfer coefficient
Basics of Radiation heat transfer

Unit IV : Convective Heat Transfer (Forced Convection)
Convection heat transfer - boundary layer theory, Flow over a flat plate, Drag coefficient and drag force, thermal boundary layer, Evaluation of convection heat transfer coefficient, Boundary layer thickness and Skin friction coefficient, Turbulent flow over a flat plate, Forced convection inside tubes and ducts Heat transfer coefficient for Laminar flow in a tube with constant heat flux and constant wall temperature

Unit V : Dimensional Analysis and Dimensionless Parameters
Principle of similarity applied to heat transfer
Derivation of dimensionless parameters from the differential equations for forced convection, natural convection and unsteady heat conduction and the significance of these numbers – Reynold's number, Peclet number, Nusselt number, Grashof number and Fourier number
Dimensional analysis by Rayleigh's method and Buckingham pi- theorem

Text books
1. *Heat Transfer* by P.K. Nag, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002

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2. J.M.Coulson and J.F.Richardson: *Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer*. Butterworth-Heinemann, an imprint of Elservier, Sixth Edition, Indian Reprint, 2006.

CL210 UNIT OPERATIONS IN FOOD PROCESSING II

Credit : 4:0:0 **Marks (40+60)**

Unit I : Adsorption and Diffusion
Basics of adsorption, Diffusion of gases in liquid and solid foods. Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components Applications of diffusion and migration in food packaging.

Unit II : Mechanical Separations
Filtration and sedimentation, gravity sedimentation, Sedimentation of solid particles in gas media. Examples Industrial applications and equipments for Filtration and Sedimentation

Unit III : Centrifugal Separation
Sedimentation and filtration centrifuges, Basic equations. Different types of centrifuges – Basket, Tubular Bowl, Decanting, Disk bowl, Desludging (Self Cleaning) Bowl Centrifuges, Nozzle centrifuges. Importance of balancing of rotating masses, feed and discharge arrangement in each case. Specific characteristics, advantages and applications.

Unit IV : Membrane Filtration
Definitions; Reverse Osmosis (RO), Nano filtration (NF), Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.

Unit V : Roasting and Cooking
Theory, Different kinds of Roasters, Steam Cookers. Extrusion cooking. Single and Twin Screw Extruders. Forming extruders and snack food extruders. Advantages of Extrusion cooking over conventional cooking.

Text/Reference Books

1. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's *Chemical Engineering*- Vol 2, *Particle Technology and Separation Processes*, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.
2. Rakesh Singh and S.H.Rizwi: *Bio Separation Process in Foods*, Marcel Dekker Inc. Hong Kong
3. G.M.Schneider, E. Stahl and G.Wilke: *Extraction with Supercritical Gases*, Verlag Chemie publishing, Basel
4. F.J. Fryer, D.L. Pyle and C.D. Rielly: *Chemical engineering for the Food Industr*, Blackie Academic and Professional, London, Chennai
5. Brennen: *Food Engineering Operations* (Vol 1 and 2), Elsevier Publishing

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6. Jimmy L. Humphry and G. E. Keller: *Separation Process Technology,* Mcgraw Hill New York
7. A.S.Grandison and M.J.Lewis: *Separation processes in the Food and Biotechnology industries (Principles and applications)*: Woodhead publishing Ltd. Cambridge UK
8. Maynord Joslyn and J.L.Heid: *Food Processing Operations* (3 Volumes) AVI Publishing company Inc. USA 1986

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SUBJECTS (Bioinformatics)

Code	Subject Name	Credit
BI201	Basics of Bioinformatics	4:0:0
BI202	Genomics	4:0:0
BI203	Proteomics	4:0:0
BI204	Bioinformatics Lab I	0:0:2
BI205	Molecular Evolution and Phylogeny	4:0:0
BI206	Molecular Modeling and Structure Prediction	4:0:0
BI207	Biopharmaceutical Technology	4:0:0
BI208	Bioinformatics Lab II	0:0:2
BI209	Introduction to System Biology	4:0:0

BI201 BASICS OF BIOINFORMATICS

Credit : 4:0:0 **Marks (40+60)**

Unit I Introduction to Bioinformatics

Scope of Bioinformatics – Elementary commands and Protocols, ftp, telnet, http. Printer on information theory. Databanks – nucleotide databanks – Genbank, NCBI, EMBL, DDBJ – protein databanks – sequence databanks – PIR, SWISSPROT, TrEMBL _ structural databases – PDB, SCOP, CATH.

UNIT II : Sequencing Alignment and Dynamic Programming

Introduction – Strings – Edit distance two strings – string similarity local alignment -gaps – Parametric sequence alignments – suboptimal alignments – multiple alignment – common multiple alignment methods.

Unit III : Sequence Databases and Their Uses

Introduction to databases – database search – Algorithms issues in database search – sequence database search – FASTA – BLAST – Amino acid substitution matrices PAM and BLOSUM. GCG Sequence Analysis(Basic concepts only)

UNIT IV : Evolutionary Trees and Phylogeny

Ultrasonic trees – parsimony – Ultrametric problem – Perfect phylogeny – Phylogenetic alignment – connection between multiple alignment and tree construction.

UNIT V : Special Topics in Bioinformatics

DNA Mapping and sequencing – Map alignment – Large scale sequencing and alignment – Shotgun – DNA sequencing – Sequence assembly – Gene predictions – Molecular predictions with DNA strings.

Text Book

1. *Dan Gusfield, Algorithms On Strings Trees And Sequences, Cambridge University Press, 1997.*

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Reference Books

1. Lesk, *Introduction to Bioinformatics*
2. Pennington, *Proteomics from Protein Sequence to Function*
3. Campell, *Discovering Genomics, Proteomics and Bioinformatics*
4. Baxevenis, B*ioinformatics, John Wiley & Sons*

BI202 GENOMICS

Credit : 4:0:0 **Marks (40+60)**

UNIT I

Introduction – Organization and structure of genomes – Genome size - Sequence complexity – Introns and Exons – Genome structure in viruses and prokaryotes – Isolation of chromosomes – chromosome microdissection – Retrofitting

UNIT II

Sequencing methods and strategies – Automated DNA sequencing – DNA sequencing by capillary array electrophoresis – High throughput sequencing – Restriction enzyme fingerprinting – marker sequences – Hybridization assays – Physical mapping without cloning.

UNIT III

Genome annotation – traditional routes of gene identification – detecting open-reading frames – software programs for finding genes - Identifying the function of a new gene – gene ontology – overview of comparative genomics – Protein structural genomics – introduction – determining gene function by sequence comparison and through conserved protein structure

UNIT IV

Global expression profiling – Introduction – traditional approaches to expression profiling – analysis of RNA expression – applications of genome analysis and genomics.

UNIT V

Analysis of Genomes – Human – Mouse – Plasmodium Falsiparum – Saccharomyces *cerevisiae – Mycobacterium tuberculosis.*

Reference books:

1. S.B.Primrose and R.M. *Twyman Principles of Genome analysis and Genomics* — Blackwell Publishing.
2. S. Sahai, *Genomics and Proteomics, Functional and Computational Aspects*, Plenum Publication, 1999.
3. Campell, *Discovering Genomics, Proteomics and Bioinformatics*

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BI203 PROTEOMICS

Credit : 4:0:0 **Marks (40+60)**

UNIT I

Introduction to Proteomics – The Proteome – Mining proteomes- Bridging Genomics and Proteomics- Proteomics and the new biology

UNIT II

Analysis of proteomes- Two-dimensional polyacrylamide gel electrophoresis- Sample preparation- Solubilization, Reduction, Resolution- Reproducibility of 2-DE- Detecting proteins in polyacrylamide gels-Image analysis of 2-DE gels

UNIT III

Mass spectrometry based methods for protein identification- *De novo* sequencing using mass spectrometric data- Correlative mass spectrometric based identification strategies- 2-DE gel electrophoresis coupled with mass spectrometry

UNIT IV

Micro array techniques- Types of micorarrays-Designing a microarray experiment- Microarray Technology in Treating Disease

UNIT V

Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications – Proteomics in drug Discovery in human - phage antibodies as tools- Glycobiology and Proteomics- In plant genetics and breeding

Text book

1. Pennington & Dunn, *Proteomics from protein sequence to function,* I edition.

Reference book

2. Campell, *Discovering Genomics, Proteomics and Bioinformatics*

BI204 BIOINFORMATICS LAB - I

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BI205 MOLECULAR EVOLUTION AND PHYLOGENY

Credit : 4:0:0 **Marks (40+60)**

UNIT I

Introduction to molecular evolution- Archaeology of the genome- fundamentals of Population genetics-The nature of molecular evolution- Driving forces in evolution- evolutionary changes in nucleotide sequences

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UNIT II

Molecular phylogenetics- Terminology of phylogenetic trees- Trees and distances- Molecular phylogenetic archaeology - Molecular phylogenetic examples- The universal phylogeny

UNIT III

Measuring genetic change- Sequence alignment and homology- Genetic distance-Measuring evolutionary change on a tree- kinds of data- Methods of reconstruction- Distance matrix methods, Maximum parsimony methods, Maximum likelihood methods- analysis of true tree- Problems associated with phylogenetic reconstruction

UNIT IV

Models of molecular evolution- Modes of evolutionary process- Functional constraints and the rate of substitution patterns of codon usage and base composition- Molecular clocks- evaluation of molecular clock hypothesis - Neutral theory- Genetic variation within species- Natural selection

UNIT V

Applications of molecular phylogenetics- Organismal phylogeny- Gene trees and species trees- Age and rates of diversification phylogeny in molecular epidemology- Host parasite co- speciation

Reference books:

1. Dan Graur and Wen-Hsiung Li.*Fundamentals of Molecular evolution,* , II ed.,2000.,Sinauer Associates, INC.
2. Roderic D. M. Page, Edward C. *Holmes Molecular evolution, A phylogenetic approach,* Blackwell Science Inc; (October 1998)

BI206 MOLECULAR MODELLING AND STRUCTURE PREDICTION

Credit : 4:0:0 **Marks (40+60)**

UNIT

Introduction - Useful Concepts in Molecular Modelling : Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature. Mathematical Concepts.

UNIT II

Force Fields. Bond Stretching. Angle Bending. Introduction to Non-bonded Interactions. Electrostatic Interactions. Van der Waals Interactions. Hydrogen Bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.Energy Minimisation and Related Methods for Exploring the Energy Surface.

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UNIT III

Computer Simulation Methods. Calculation of Simple Thermodynamic Properties. Phase Space. Practical Aspects of Computer Simulation. Boundaries. Long-range Forces. Analyzing the Results of a Simulation and Estimating Errors.

UNIT IV

Molecular Dynamics Simulation Methods. Molecular Dynamics Using Simple Models. Molecular Dynamics with Continuous Potentials. Setting Up and Running a Molecular Dynamics Simulation. Molecular Dynamics at Constant Temperature and Pressure. Monte Carlo Simulation Methods - Calculating Properties by Integration. Some Theoretical Background to the Metropolis Method. Implementation of the Metropolis Monte Carlo Method. Monte Carlo Simulation of Molecules. Models Used in Monte Carlo Simulations of Polymers Molecular Modeling softwares – Insight II, DS Modeling(Basic concepts only)

UNIT V

Protein Structure Prediction, Sequence Analysis and Protein Folding. Some Basic Principles of Protein Structure. First-principles Methods for Predicting Protein Structure. Introduction to Comparative Modeling. Sequence Alignment. Constructing and Evaluating a Comparative Model. Predicting Protein Structures by 'Threading.' A Comparison of Protein Structure Prediction Methods: CASP. Protein Folding and Unfolding.

Reference Books:

1. A.R.Leach, *Molecular Modelling Principles and Application*, Longman, 1996.
2. J.M.Haile, *Molecular Dynamics Simulation Elementary Methods*, John Wiley and Sons, 1997.

BI207 BIOPHARMACEUTICAL TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT I

Introduction - Development of Drugs and Pharmaceutical Industry – Organic therapeutic agents uses and Economics

Drug Metabolism and Pharmacokinetics - Drug Metabolism – Physico-Chemical Principles – Radio Activity – Pharmacokinetics – Action of drugs on human bodies.

UNIT II

Important Unit Processes and their Applications - Chemical conversion processes – Alkylation – Carboxylation – Condensation and Cyclisation – Dehydration, Esterification (Alcoholysis) – Halogenation – Oxidation Sulfonation – Complex Chemical Conversions – Fermentation

UNIT III

Manufacturing Principles - Compressed tablets – wet granulation – Dry granulation or slugging – Direct compression – Tablet presses formulation – Coating – Pills – Capsules

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sustained action dosage forms – Parental solutions – Oral liquids – injections – ointments – standard of hygiene and good manufacturing practice.

UNIT IV

Pharmaceutical Products, Analysis and Control - Vitamins – Cold remedies – Laxatives – Analgesics – Non-steroidal contraceptives – External Antiseptics – Antacids and others. Antibiotics – Biologicals – Hormones – Vitamins – preservation. Analytical methods and tests for various drugs and pharmaceuticals. Packing – Packing Techniques – Quality Control - Recent advances in the manufacture of drugs using
r-DNA technology.

UNIT V

Clinical Trials & Regulations - Clinical Trials – Design, double blind studies, placebo effects, FDA regulations (General) and Indian Drug regulations- highlights. The Use of Molecular Modelling, Chemoinformatics, Cerius 2 and QSAR to Discover and Design New Molecules.

Reference books

1. A C Guyton, *Text Book of Medical Physiology*, WB Saunders, Hong Kong, 1986.
2. Remington's *Pharmaceutical Sciences*, Mack Publishing and Co.,

BI208 BIOINFORMATICS LAB II

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BI209 INTRODUCTION TO SYSTEMS BIOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT I

Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems Modeling Genetic Networks

UNIT II

Modeling the Activity of Single Gene - A Probabilistic Model of a Prokaryotic Gene and its Regulation
Modeling Biochemical Networks - Atomic-Level Simulation and Modeling of Biomacromolecules

UNIT III

Kinetic Models of Excitable Membranes and Synaptic Interactions - Stochastic Simulation of Cell Signaling Pathways -Analysis of Complex Dynamics in Cell Cycle Regulation

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UNIT IV

Modeling Large Biological Systems from Functional Genomic Data: Parameter Estimation - Cellular Simulation - Towards a Virtual Biology Laboratory - Computational Cell Biology : The Stochastic Approach

UNIT V

Computer Simulation of the Whole Cell - Computer Simulation of the Cell: Human Erythrocyte Model and its Application - Software for Modeling and Simulation – E-CELL, V-CELL and GROMOS

Reference books:

1. *Foundations of Systems Biology*, Hiroaki Kitano (Editor),MIT Press, 2001
2. *Computational Modeling of Genetic and Biochemical Networks*, James M. Bower, Hamid Bolouri, MIT Press,2000.
3. *Gene Regulation and Metabolism: Postgenomic Computational Approaches*, Julio Collado-Vides (Editor), Ralf Hofestadt (Editor),MIT Press,2002

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SUBJECTS (Biotechnology)

Code	Subject Name	Credit
BT201	Basic Industrial Biotechnology	4:0:0
BT202	Enzyme Engineering and Technology	4:0:0
BT203	Genetic Engineering	4:0:0
BT204	Genetic Engineering Lab	0:0:1
BT205	Bioprocess Principles	4:0:0
BT206	Bioprocess Lab	0:0:2
BT207	Plant Biotechnology	4:0:0
BT208	Bioprocess Engineering	4:0:0
BT209	Metabolic Engineering	4:0:0
BT210	Down Stream Processing	4:0:0
BT211	Down Stream Processing Lab	0:0:2
BT212	Immunology	4:0:0
BT213	Immunology Lab	0:0:2

BT201 BASIC INDUSTRIAL BIOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction to Industrial Bioprocess

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

UNIT – II Production of Primary Metabolites

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT – III Production of Secondary Metabolites

Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

UNIT – IV Production of Enzymes and Other Bioproducts

Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc.,and enzyme inhibitors such as inhibitors of cholesterol synthesis. Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc.,), single cell protein.

UNIT – V Production of Modern Biotechnology Products

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture.

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Text Book:

1. Casida Jr, L.E., *Industrial Microbiology*, New Age International (P) Ltd.

References

1. Presscott, Dunn, *Industrial Microbiology*, Agrobios (India).
2. Wulf Cruger and Anneliese Crueger, *Biotechnology: A Textbook of Industrial Microbiology*, Panima Publishing Corporation.
3. Murrey Moo & Young, *Comprehensive Biotechnology*, Pergamon.

BT202 ENZYME ENGINEERING AND TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction to Enzymes

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT – II Kinetics of Enzyme Action

Kinetics of single substrate reactions; Estimation of Michelis – Menten parameters, Lineweaver – Burk Plot, Multisubstrate reactions-introduction to ping-pong bi-bi mechanism, random – order mechanism and compulsory order mechanisms; Turnover number; types of inhibition & models for substrate and product. Allosteric regulation of enzymes, Monod - Changeux -Wyman model, pH and temperature effect on enzymes & deactivation kinetics.

UNIT – III Enzyme Immobilization

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages. Immobilised enzyme bioreactors

UNIT – IV Purification and Characterization of Enzymes from Natural Sources

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

UNIT – V ENZYME BIOSENSORS

Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment

Text Book

1. Wiseman, *Enzyme Biotechnology*, Ellis Horwood Pub.
2. Palmer T. *Enzymes : Biochemistry, Biotechnology and Clinical Chemistry*, First East – West Press Edition, 2004

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References

1. Harvey W. Blanch, Douglas S. Clark, *Biochemical Engineering*, Marcel Dekker, Inc.
2. James M. Lee, *Biochemical Engineering*, PHI, USA.
3. James. E. Bailey & David F. Ollis, *Biochemical Engineering Fundamentals*, McGraw Hill.

BT203 GENETIC ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Basics of Recombinant DNA Technology

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT – II Creation of Recombinant Molecules

Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT – III Construction of Libraries

Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT – IV Polymerase Chain Reaction

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing- Sanger's method, (Kunkel's Method). Diagnostic importance.

UNIT – V Applications of Recombinant DNA Technology

Cloning in plants, transgenic and knockout animals. Recombinant cytokines and antibodies, vaccines, gene-therapy, stem cell therapy. Invitro fertilization, embryo transfer technology.

Text Book

1. Old RW, Primrose SB, *"Principles Of Gene Manipulation, An Introduction To Genetic Engineering* ", Blackwell Science Publications, 1993.

Reference books

1. 1.Ansubel FM, Brent R, Kingston RE, Moore DD, *"Current Protocols In Molecular Biology "*, Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, *"Methods In Enzymology"*, Vol 152, Academic Press, 1987
3. Sambrook et al Vol. 1-3, *"Molecular Cloning"*

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BT204 GENETIC ENGINEERING LAB

Credit : 0:0:1 **Marks (50+50)**

6 experiments will be notified by the HOD from time to time

BT205 BIOPROCESS PRINCIPLES

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Overview of Fermentation Processes

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT – II Raw Materials and Media Design for Fermentation Process

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

UNIT – III Sterilization Kinetics

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of depth filters, design of sterilization equipment - batch and continuous.

UNIT – IV Metabolic Stoichiometry and Energetics

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT – V Kinetics of Microbial Growth and Product Formation

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

Text books

1. Shuler, M.L. and Kargi,F. " *Bioprocess Engineering - Basic concepts* – Second Edition Prentice Hall of India Pvt. Ltd., 2005
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology*, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References

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1. Bailey and Ollis, *" Biochemical Engineering Fundamentals"*, McGraw Hill (2nd Ed.), 1986.
2. Pauline Doran, *Bioprocess Engineering Calculation*, Blackwell Scientific Publications.
3. Harvey W. Blanch, Douglas S. Clark, *Biochemical Engineering*, Marcel Dekker, Inc.

BT206 BIOPROCESS LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BT207 PLANT BIOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I: Agrobacterium and Plant Genetic Engineering
Agrobacterium mediated gene transfer and cloning. Types of plant vectors and their use in gene manipulation.

Unit II : Plant Viruses
Classification, diagnosis – remedy – viruses as a tool to deliver foreign DNA.

Unit III : Developmental Aspects of Rhizobium
Legume Symbiosis, Symbiotic Nitrogen Fixation, Regulation of nif and nod genes.

Unit IV: Molecular Aspects of Disease Susceptibility and Resistance
Transposable elements, factors influencing disease resistance and susceptibility RFLP.

Unit V: Transgenics
Stress tolerance - Biotic and abiotic temperature, salinity, drought etc. Pests and insects resistance – viral resistance – development of disease resistant plants by introducing *Bacillus thuringiensis* genes.

Text & Reference Books:

1. Mantal S.H., Mathews J.A., Mickee R.A., *Principles of Plant Biotechnology*. An Introduction to Genetic Engineering in Plants, Blackwell Scientific Publication, 1985.
2. Marx J.L., *Revolution in Biotechnology*, Cambridge University Press, 1989.
3. Dodds J.H., *Plant Genetic Engineering*, Cambridge University Press, 1985.

BT208 BIOPROCESS ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Analysis of STR Stirred tank reactor - non-ideality, RTD and stability analysis, tanks in series and dispersion models – application to design of continuous sterilizer.

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UNIT – II Analysis of Other Configurations
Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors – non-ideality, RTD and stability analysis.

UNIT – III Bioreactor Scale – up
Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT – IV Modelling and Simulation Of Bioprocesses
Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT – V Bioreactor Consideration in Enzyme Systems
Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors.

Text Book

1. James E. Bailey & David F. Ollis, *Biochemical Engineering Fundamentals*, McGraw Hill.

References

1. Anton Moser, *"Bioprocess Technology, Kinetics and Reactors"*, , Springer Verlag.
2. James M. Lee, *Biochemical Engineering*, PHI, USA.
3. Atkinson, *Handbook of Bioreactors*,
4. Harvey W. Blanch, Douglas S. Clark, *Biochemical Engineering*, Marcel Decker Inc.

BT209 METABOLIC ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction
Jacob Monod model for gene expression regulation-Lac operon, catabolite regulation-glucose effect- cAMP deficiency. Regulation of RNA synthesis by amino acid. Feed back regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, permeability control: passive diffusion, active transport, group transportation.

UNIT – II Synthesis Of Primary Metabolites
Alteration of feed back regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites.

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UNIT – III Biosynthesis Of Secondary Metabolites
producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

UNIT - IV Bioconversions
Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

UNIT - V Regulation Of Enzyme Production
Strain selection, improving fermentation, recognising growth cycle peak, induction, feed-back repression, catabolite repression, mutants resistant to repression, gene dosage.

Text books

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology*, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., *" Fermentation And Enzyme Technology "*, John Wiley And Sons., 1980.
2. Zubay G., *" Biochemistry "*, Macmillan Publishers, 1989.

BT210 DOWNSTREAM PROCESSING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Downstream Processing
Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT – II Physical Methods of Separation
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT – III Isolation of Products
Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT – IV Product Purification
Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

UNIT – V Final Product Formulation and Finishing Operations
Crystallization, drying and lyophilization in final product formulation.

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Text Book

1. P.A. Belter, E.L. Cussler And Wei-Houhu – *Bioseparations – Downstream Processing For Biotechnology*, Wiley Interscience Pun. (1988).
2. R.K. Scopes – *Protein Purification* – Principles And Practice, Narosa Pub. (1994).

References

1. R.O. Jenkins, (Ed.) – *Product Recovery In Bioprocess Technology* – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
2. J.C. Janson And L. Ryden, (Ed.) – *Protein Purification* – Principles, High Resolution Methods And Applications, VCH Pub. 1989.

BT211 DOWNSTREAM PROCESSING LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BT212 IMMUNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction

Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

UNIT – II Cellular Responses

Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.

UNIT – III Infection and Immunity

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immunodeficiencies; resistance and immunisation; Vaccines.

UNIT – IV Transplantation and Tumor Immunology

Transplantation: genetics of transplantation; laws of transplantation; tumor immunology. Autoimmunity; Autoimmune disorders and diagnosis.

UNIT – V Immuno-Techniques

ELISA, Immunoelectrophoresis, RIA, SDS-PAGE, non-isotopic methods for detection of antigens, chemiluminescence assay, immunohistochemistry, monoclonal and polyclonal antibody production

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Text Book

1. Tizard, *Immunology*., 4th Edition.

Reference books

1. Roitt I, Male, Brostoff. *Immunology*, Mosby Publ., 2002.
2. Kuby J, *Immunology*, WH Freeman & Co., 2000.
3. Ashim K. Chakravarthy, *Immunology*, TataMcGraw-Hill, 1998.

BT213 IMMUNOLOGY LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

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SUBJECTS (Food Processing)

Code	Subject Name	Credit
FP201	Food Chemistry	3:1:0
FP202	Engineering Properties of Foods	4:0:0
FP203	Fruit and Vegetable Technology	4:0:0
FP204	Food Additives	3:1:0
FP205	Dairy Technology	4:0:0
FP206	Cereal Technology	4:0:0
FP207	Sugarcane & Confectionery Technology	4:0:0
FP208	Meat Technology	4:0:0
FP209	Plantation Products and Spices Technology	4:0:0
FP210	Food Packaging Technology	4:0:0
FP211	Milling and Bakery technology	4:0:0
FP212	Analysis of Food Constituents - 1	0:0:2
FP213	Processing of Food –1	0:0:2
FP214	Analysis of Food Constituents – 2	0:0:2
FP215	Food Additives Lab	0:0:2
FP216	Analysis of Food Commodities – 1	4:0:0

FP201 FOOD CHEMISTRY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Water and ice

Importance of water in foods. Structure of water & ice. Concept of bound & free water & their implications. .Sorption Phenomena and Sorption isotherms, examples – Dispersed systems – some basic considerations

Chemistry of Carbohydrates: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars

Unit II : Chemistry of Polysaccharides

Chemistry, properties and preparation of Pectic substances, gums & polysaccharides, Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins

Unit III : Chemistry of Lipids

Definition & classification of lipids. Basic Structures, Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospolipids, and unsaponifiables, Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, hydrogenated fats, shortening agents, confectionary fats etc. Rancidity of fats & oils, and its prevention, antioxidants. Process flow sheet for the manufacture of edible oils (refined and hydrogenated)

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Unit IV : Chemistry of Proteins

Importance of Proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides & Proteins. Sources and distribution of Proteins. Isolation, identification & purity of Proteins. Denaturation. Physical & chemical characteristics of Proteins.

Enzymes: Introduction, Nature, Function, classification & nomenclature of enzymes. Specificity. Amylases, Pectic Enzymes, Proteases; Oxidoreductases- Phenolases, Glucose Oxidases, Catalases, Peroxidases, Lipoxygenases, Xanthine Oxidases, Immobilized enzyme- One example of working of each enzyme. Assay Techniques. Isolation & purification of enzymes & their importance.

Unit V : Chemistry of Vitamins

Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins – Reasons for the loss of vitamins in foods – Fat-soluble and water soluble vitamins – Choline, carnitine

Text Books and Reference Books:

1. Owen R Fennema : *Food Chemistry – III edition* Marcel Dekkar Inc. New York (1996).
2. L.H.Meyer : *Food Chemistry* Van Nostrand Reinhold Co. New York, (1960)
3. H-D Belitz, W Grosch and P Schieberle: *Food Chemistry - 3rd Edition (2004)* Springer Verlag March 2004
4. John M Demann: *Principles of Food Chemistry* AVI Publishing Co, West port, USA 1974
5. Zdzislaw E. Sikorski: *Chemical and Functional Properties of Food Components* Technomic Publishing, Lancaster, USA 1997
6. Eskin, N. A. With Henderson, H. M : *Biochemistry Of Foods* Harcourt Publishers Ltd, USA (Edition #2, 1990)
7. David S.Robinson: *Food Biochemistry and Nutritional Value* Longman Scientific and Technical Publishers, USA (1987)
8. J.B.S.Breverman: *Introduction to Biochemistry of Foods* Elsevier Publishing Company, USA (1963)
9. Pieter Walstra: *Physical Chemistry of Foods* Marcel Dekker Publishing, New York (2003)
10. Zd Zislaw and E.Sikroski: *Chemical and functional Properties of Food Components:* Technomic Publishing company, USA (1997)
11. T.P.Coulate: *Food – Chemistry of its Components* Royal Society of Chemistry, USA (1984)

FP202 ENGINEERING PROPERTIES OF FOODS

Credit : 4:0:0 **Marks (40+60)**

Unit I : Rheological Properties of Liquid Foods

Rheological Classification and models; effect of Temperature on Rheological properties, effect of concentration on viscosity, Rheological models for visco-elastic fluids, measurement methods, Viscometers and Rheometers of different design and their applications

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Unit II : Rheological Properties of Solid Foods

Static tests for solid foods, Rheological models, Creep, relaxation, Dynamic testing of solid foods, stress and strain in solid foods, stress-strain diagrams, texture measuring instruments, Hardness and brittleness of grains, flow of powders and grains in chutes an channels, compaction and emptying problems of floury foods in silos and bins,

Unit III : Thermal Properties of Foods

Definitions - specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity; Predicting thermal properties, different models and their applications; Thermal properties of frozen foods, methods of measurements, Modelling thermal properties of frozen foods,

Unit IV : Diffusion of gases in Liquid and Solid Foods

Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components Applications of diffusion and migration in food packaging.

Thermodynamic Properties of Foods in Dehydration:

Thermo dynamics of food-water systems, Fugacity and activity, Water activity in foods, measurement of water activity, Moisture sorption isotherms and their applications, Sorption energetics. Concept of equilibrium moisture content in foods. Constant and falling rates of drying of foods.

Unit V : Electrical properties of foods

Dielectric properties, electric energy transmission properties, Electro-magnetic field effects, Dielectric measurements, Polar solvents, Ionic solutions, Prediction of food dielectric properties.

Text/reference Books

1. M.A.Rao and S.S.H.Rizvi: Engineering Properties of Foods Mercel Dekker inc. New York (1998)
2. M.J.Lewis: *Physical Properties of Foods and Food Processing Systems* Woodhead Publishing Cambridge, UK (1990)
3. Reynold Jewitt and Others: *Physical Properties of Foods* Allied Science Publishers (1983)
4. Shafiur Rehman: *Food Properties Hand Book* CRC Press Inc. New York (1995)
5. J.H.Prentice: *Measurements in the Rheology of Food Stuffs* Elsevier Applied Science Publishers (1984)
6. Micha Peleg and Edward B.Bagley: *Physical Properties of Foods* AVI Publishing company Inc, Westport USA (1983)
7. Nuri N. Mohsenin: *Physical Properties of Plant and Animal Materials* Gordon and Reach Science Publishers (1970)
8. R. P.Kachru and R.K.Gupta: *Physico-Chemical Constituents and Engineering Properties of Food Crops* : Scientific Publishers, Jodhpur.

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FP203 FRUIT AND VEGETABLE TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I Introduction

Production of Fruits and vegetables in India. Cause for heavy losses, Composition of each of the major fruits and vegetables produced in the country-Mangoes, Pineapple, Guava, Papaya, Grapes etc. among fruits, Beans, Carrot, Tomatoes, Potato, Onion Brinjal etc. among Vegetables. Spoilage factors, Post harvest field operations, preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. General methods of preservation of whole fruits/Vegetables and processed fruits and vegetables.

Unit II Canning of Fruits and Vegetables

Commercial products from each of the fruits and vegetables. Reception, sorting and Storage operations for fruit and vegetables. Canning operations, Preparation for canning. – Washing, peeling, grating, slicing dicing, deseeding etc for each product. Juice and pulp extraction and clarification. Common machinery for operations like Peeling, Slicing/Dicing, Pulping, Grating, Hydraulic Pressing and Clarification. Bottled Products: Preparation of products like Jams, Jellies, Marmalades, Pickles, Puree, Ketchup, Sauce, Squashes etc. Flow diagram in each case. Different types Glass and Plastic Containers, Large capacity storage containers in plastic, Bulk preparation and storage of Mango pulp, in plastic and SS containers. Different filling, closing and sterilization operations. Different preservatives used for long and short-term storage.

Canning of Vegetables. Preparation of vegetables for canning operations. Precautions in Canning operations. Importance of Blanching operations. Batch and Continuous Blanching. Hot water and Steam Blanching. Pickling operations. Preparation and packaging of Pickles. Minimal Processing and packaging of vegetables, Brief study of Hurdle technology as applied to Vegetable and Fruit processing.

Unit III Processing of fruit juices

Preparation of specialty products like, Fruit juice concentrates, Fruit Bars and Fruit powders. Different kinds of evaporators used for concentration of fruit juices and pulp. Clarification of juices, Viscosity problems. Tomato products – Hot and Cold Break processes. Tomato Deseeding and clarification. Mango Pulp extraction and concentrations. Tubular, Plate and scraped surface evaporators. Clarification centrifuges – Decanters and desludgers. Fruit juice aroma Recovery and its importance. Brief on Aroma Recovery equipment.

Unit IV Dehydration

Dehydrated products. Dried Vegetable Slices and Dices. Preparation of product for dehydration. Dehydration principles and equipment used for drying. Cross Flow Shelf Dryers, Vacuum Shelf Dryers, Freeze Dryers. Simple estimation of drying costs. Freeze drying Principles. Merits and demerits of Freeze Drying. Preparation of Fruit Powders. Working of Spray Dryer and Drum Dryer. Preparation of Fruit material for powder production. Packaging of Dried slices, Dices and powder.

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Unit V Aseptic and other methods of processing

Aseptic processing and Bulk packing of Fruit juice concentrates, Pulps and Puree Brief information on Asepticity and how it is strictly maintained in the plant. Aseptic heat exchangers for sterilizing and concentrating the product. Aseptic fillers. Different system of filling practiced. Tetra pack for small quantities, Dole system and Scholle system for bulk storage in Bag & Boxes and Bag & Drums. Storage of Aseptically packed products.
Minimal processing – Basic concepts, Reverse osmosis

Text/Reference Books

1. Dauthy, M.E.: *Fruit and Vegetable Processing*. International Book Distributing Co. Lucknow, India. (1997)
2. Hamson, L.P: *Commercial Processing of Vegetables.* Noyes Data Corporation, New Jersey. (1975)
3. Jagtiani J., Chan, H.T. and Sakal, W.S.: *Tropical Fruit Processing* Academic Press, London. (Ed. 1988)
4. Lal, G., Siddappa, G. and Tondon G.L. : *Preservation of Fruits and Vegetables*, Indian Council of Agricultural Research, New Delhi. (1986)
5. Y.H.Hui and Others: *Hand Book of Vegetable Preservation and Processing* Mercel Dekker New York 2004
6. Salunkhe, D.K. and Kadam, S.S.: *Handbook of Fruit Science and Technology: Production, Composition and Processing*. Marcel Dekker, New York. (1995)
7. Salunkhe, D.K. and Kadam, S.S.: *Handbook of Vegetable Science and Technology. Production, Composition, Storage and processing* Marcel Dekker, New York. (1995)
8. Seymour, G.B., Taylor, J.E. and Tucker, G.A: *Biochemistry of Fruit Ripening.* Chapman and Hall, London. (1993)
9. Srivastava, R.P. and Kumar, S.: *Fruit and Vegetable Preservation: Principles and Practices.* International Book Distributing Co. Lucknow (2nd Edition 1998).
10. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. *Handbook of Post-harvest Technology:* Marcel Dekker Press, USA (2001)
11. Srivastava,R.P., and Sanjeev Kumar: *Fruit and vegetable preservation; principles and practices.:* International Book Distributing Co., Lucknow. 1998
12. Manorajan Kalia and Sangita Sood.. *Food Preservation and Processing,* Kalyani Publishers, Ludhiana. 1996

FP204 FOOD ADDITIVES

Credit : 3:1:0 **Marks (40+60)**

Unit I

Introduction – food additives definition – Determination of the limit for addition – NOEL – Toxicity data – Method of determining toxicity – LD50, carcinogenicity, teratogenicity – PFA, FDA, FPO regulations – GRAS additives

Unit II

Types, chemical properties, levels of additions in individual products, toxicity data of Acidulants – Preservatives – Emulsifiers and gums - Antioxidants

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Unit III
Types, chemical properties, levels of additions in individual products, toxicity data of Dough conditioners - flour improvers – Humectants –Enzymes, Starches

Unit IV
Types, chemical properties, levels of additions in individual products, toxicity data of Colourants – Natural and artificial, Flavourants, Flavour enhancers, Fat substitutes and replacers

Unit V
Types, chemical properties, levels of additions in individual products, toxicity data Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives

Text book

1. *Food additives* by Brannen A.L., Davidson P.M., Salminen S. and Thorngate J.H. Second Edition, Revised and Expanded. Marcel dekker Inc. USA, 2002.
2. *Handbook of Food additives* by Thomas Furia,

FP205 DAIRY TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I Dairy Chemistry and Microbiology
Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests, Quality and Quantity tests at reception, Cell count and other tests, Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases – Dietary recommendations – Applications of enzymes in dairy industry

Unit II Dairy Processing Equipments
Milk processing terminology, Processing flow sheet, Equipment employed, Pasteurisers (Heat Exchangers), Plant piping, Pumps, Cream separating Centrifuges, Homogenizers, Bottle and pouch fillers, Milk Chillers, Ice Cream Freezers. Vacuum Evaporators, Spray and Drum Dryers, Product instantizing equipment. Packaging of milk in bottles and sachets.

Unit III Manufacture of Dairy Products
Cheese – Types of cheese, Defects in cheese, Manufacture of paneer, Toned Milk, Sweetened Condensed milk, Khoa, Milk powder – Quality aspects

Unit IV Manufacture of Ice Cream and other Dairy Products
Manufacture of Ice cream – Chemistry and technology –Microbiology of ice cream - Quality aspects
Manufacture of Butter, Ghee – Grading of butter - Quality aspects
Extraction of casein from milk, properties, composition and industrial uses

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Production of lactose and whey

Unit V Fermented dairy products

Fermented products – Yoghurt, Curd, acidophilus milk etc

Energy use in Dairy plant, sources of energy, cost of energy, Control of energy losses and Energy conservation.

Text books and Reference books

1. National Institute of Industrial Research, *Modern Technology of Milk processing and Dairy products*, II Edition, NIIR Publications, India, 2004.
2. Tufail Ahmad: *Dairy Plant Systems Engineering* Kitab Mahal, Allahabad, India (1985)
3. Edger Spreer & Axel Mixa: *Milk and Dairy Product technology* Mercel dekker Inc. N.Y. (1998)
4. Arthur W. Farral: *Engineering of Dairy and food Products (II Edition 1970)* Robert E. Krieger Publishing Co. NY
5. Garret Smit : *Dairy Processing (Improved Quality)* Woodhead Publishing Ltd. CRC Press (2003)
6. W.M. Clunie Harvey and Harry Hill: *Milk Products* Bio Tech Books, New Delhi (1999)
7. Prof. H.G. Kessler: *Food Engineering and Dairy Technology* Verlog Kessler Publishing House, Germany (1981)
8. W. James Harper and Carl W. Hall: *Dairy Technology and Engineering* AVI Publishing, Westport, USA (1976)
9. Edger Spreer: *Milk and Dairy Product Technology* Mercel Dekkar Inc. New York, USA (2005)

FP206 CEREAL TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I Paddy Processing:

Paddy Varieties, Their Composition and Quality characteristics. Curing of Paddy. Parboiling Processes, Cold Water soaking and Hot water soaking processes, Paddy Dryer-LSU Dryer. By Products of Paddy Processing - Paddy husk and its uses - as boiler fuel, husk ash, activated carbon, furfural and other by products. Production of Flattened Rice and Puffed Rice from Paddy

Unit II Rice Milling:

Paddy Dehusking Processes. Rice Mill Flow Chart. Engelberg Huller Mills, Modern Rice Mills. Components of modern Rice mill, Pre Cleaners, Shellers, Under Runner Shellers and Centrifugal Shellers, Paddy Separators – Satake and Schule Designs, Polishers-Cone polishers and other types, Bran and Brokens separators. Rice Mill yields and loss due to brokens at different stages of milling. Rice Mill machinery handling. Use of Rice Bran in Edible oil Industry.

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Unit III Milling of Pulses:
Major Pulses grown in the country and their application, Status of Pulse milling industry in India, need for modernization, Traditional milling process, merits and demerits, Drying of legumes, Sun drying, Traditional Processing steps – Pre-cleaning, Pitting, Oil application, conditioning, Dehusking and splitting, Machinery and equipment employed, mass balance, losses during milling; Modern milling process, Mechanical hot air drying and conditioning, merits and demerits, Dehusking in Pulse Pearler, Water conditioning, splitting of pulses in Pulse splitter, process flow chart, Merits and demerits, Mini dal mill, working principle, advantages and disadvantages, Grinding of split pulses, pulse flour products, their applications, equipment used.

Unit IV Milling and Processing of Maize:
Dry milling of maize: Storage and drying, Pre-cleaning, cleaning equipment, Degermination and Dehusking, Roller milling, Sifting, Purifying, Aspiration, Pneumatics in a maize mill. Products of milling-Flour, Semolina, Brewers' grits etc. and their applications.
Wet milling of Maize and corn: Modern methods of processing, Cleaning, Steeping, Degermination, Bran and Fibre separation, Gluten and Starch Separation, extraction process; Equipment needed for Degermination, Debranning and starch separation, Starch conversion into other value added products, Acid Hydrolysis, Enzyme Hydrolysis, Isomerization processes, Processing for Dextrose, Malto Dextrin and other products. Extraction and refining of Corn oil in brief.

Unit V Grain Storage and Handling:
Bag Storage, Advantages and Disadvantages, Bag Storage structure design, Parameters of good storage structure, Cover Plinth Storage Structures, CAP storage (Ceiling and Plinth Storage), Plans for Bag storage, lay outs, Dunnage, Materials for Dunnage, Pallets, Protection against Rodents, Fungi, Pests and Mites, Fumigation Processes for bag storage piles,
Bulk Storage in silos and large Bins; Problems of Silo storage, Construction of Silos, Physical load and mechanical strength of Silos, concrete and Metal Silos, Silo flow problems, Relative merits and demerits of Silo storage to Bag Storage, Relative Costs of Silo and Bag Storage, Conveyors and Elevators for feeding and discharging into Silos
In silo Aeration and Drying, Problems of Dust Explosion in Grain Storages, Quality Changes of Grains during storages and remedial measures to prevent unwanted quality changes.

Text/reference Books

1. Chakraverty, A.: *Post Harvest Technology of Cereals, Pulses and Oilseeds.* Oxford and IBH Publishing Co, Calcutta (1995)
2. Samuel Matz: *The Chemistry and Technology of Cereals as Food and Feed,* Chapman & Hall (1992)
3. N.L.Kent and A.D.Evans: *Technology of Cereals (4th Edition)* Elsevier Science (Pergaman), Oxford, UK, (1994)
4. George E Inglett: *Maize-Recent Progress in Chemistry and Technology* Academic Press, London (1982)
5. Ruth H. Matthews: *Pulses – Chemistry, Technology and Nutrition* Mercel Dekker Inc. USA (1989)

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6. J. Smartt: *Tropical Pulses* Longman Group Ltd. London (1980)
7. Y. Pomeranz: *Modern Cereal Science and Technology* VCH Publishing Inc. New York (1987)
8. Cryde M. Christensen: *Storage of Cereal Grains and their Products* American Association of Cereal Chemists inc., St. Paul, USA 1982
9. Bernard Godon and Claude Willm: *Primary Processing of Cereals* Berns and Noble Publishers (1994)
10. Karel Kulp and Joseph P Pante:*Hand Book Of Cereal Science and Technology* Mercel Dekkar USA (2000)

FP207 SUGARCANE AND CONFECTIONERY TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I Introduction
Sugarcane and beet as sugar raw materials. Flow charts for manufacture of Granulated sugar and Liquid sugars. Properties of Granulated sucrose and Liquid Sugars. Invert sugar and their characteristics. Specialty products of Sugar Industry. Back strap Molasses and its uses. Applications in animal feed

Unit II Sugar production process details:
Energy and material balance of cane sugar process. Extraction of juice, extraction yields, drying and uses of Bagasse, Purification of juices-juice filtration and chemical purification, Clarification stages, Lime addition, pH control, Treatment of clarified juice, evaporation – multiple effect evaporators, Vacuum pans, Crystallization, Washing of sugar crystals and centrifugal separation/dewatering of sugar and other related processes. Sugar Refining, Sugar analysis, Sugar recovery –improvement, /Sugar balance, energy conservation, Sugar plant sanitation.

Unit III : Technology of Alcoholic Beverages
Manufacture of beer and wine and champagne - Quality characteristics
Manufacture of distilled beverages including whiskey, brandy, rum and gin – Quality aspects

Unit IV : Technology of Carbonated Beverages and Confectionery
Manufacture of carbonated beverages – quality aspects – Manufacture of sugar-free, sugar-less carbonated beverages.
Confectionery manufacture
General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweets – Ingredients, Methods of manufacture – Types – Center – filled, lollipops, coextruded products
Manufacture of gums and jellies – Quality aspects

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Unit V : Manufacture of Miscellaneous Products
Caramel, Toffee and fudge – Liquorice paste and aerated confectionery, Lozenges, sugar pannings and Chewing gum, Countlines - Quality aspects

Text/Reference Books

1. E.B. Jackson: *Sugar Confectionery Manufacture*, Second edition, Aspen publishers Inc., 1999. Great Britain
2. Maurice Shachman, *Soft Drinks Companion*: A Technical Handbook for the Beverage Industry, CRC press, Florida, USA (2005)
3. W.Ray, Junk & Harry M. Pancost: *Hand Book of Sugars – for Processors, Chemists and Technologists:* AVI Puvblishing, West port (1973)
4. Oliver Lyle: *Technology of Sugar for Refinery Workers* Chapman and Hall Ltd., (1950)
5. Guilford L Spencer and George P. Made: *Cane Sugar Hand Book (1993)* John Wiley and sons Inc. London
6. P. Manohara Rao: *Industrial Utilization of Sugar Cane and its co-products* P.J.International Consultants, New Delhi
7. E.Hugott: *Hand Book of Cane Sugar Engineering* Elsevier Publishing /company, London (1986)

FP208 MEAT TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Meat, Fish and Poultry – Chemistry and Microbiology
Meat composition from different sources; Definitions and measurements, Explanation of muscle structure and compositions and its modifiers, Description of animal fat and its modifiers, description of bone and its modifiers; Post mortem muscle chemistry, Meat colour, flavors of meat products, meat microbiology and safety

Unit II Slaughtering and Carcass Processing
Modern abattoirs and some features, Ante mortem handling and welfare of animals, design of handling facilities, Hoisting rail and traveling pulley system, and stunning methods, stunning pen, slaughtering equipment, Washing area, Sticking, bleeding, dressing, Beef/Sheep and Pig Dressing operations, Offal handling and inspection, Inedible by products: Carcass processing equipment, Operational factors affecting meat quality, effects of processing on meat tenderization; meat processing equipment, electrical gadgets and manual gadgets; Water and Electric energy requirement for abattoir operations, Typical lay outs.,

Unit III Meat Products:
Canned meat, Frozen meat, Cooked and Refrigerated meat, Dried and preserved meat, Cured meat, Prepared meat products, Production methods for Intermediate moisture and dried meat products, Different kinds of sausages –Equipment used for all the process operations; Meat plant hygiene, Good manufacturing practice and HACCP. Packaging of various poultry products

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Unit IV : Processing of Poultry Products :
Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation; Poultry meat processing operations in detail along with equipment used – Defeathering, bleeding, Scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

Unit V : Fish and other Marine Products Processing
Commercially important marine products from India, Product export and its sustenance, Basic biochemistry, spoilage factors of fish, field refrigeration and icing practice, merits and demerits,
Use of dry ice and liquid nitrogen as preservation elements, use of Refrigerated Sea Water (RSW) for preservation, Changes storage with RSW; Transportation in Refrigerated trucks, Deodorization of transport trucks, Design of refrigerated and insulated trucks; Freeze preservation; freezing of prawn and shrimp, weighing, filling and grazing, Individual quick freezing, in pack freezing, relative merits and demerits, Canning operations, Salting and drying of fish, pickling and preparation of fish protein concentrate, fish oil and other by products.

Text/Reference Books

1. Joseph Kerry, John Kerry and David Ledwood: *Meat Processing* Woodhead Publishing Limited (CRC Press 2002)
2. Albert Levie: *Meat Hand Book (4th Edition)* AVI Publishing Inc. West Port, USA 1984
3. Frank Gerrard: *Meat Technology* Northwood Publications, London (1977)
4. Y.H.Hui and Others: *Meat Science and Applications* Marcel Dekkar Inc. New York (2001)
5. George J. Mountney: *Poultry Products Technology* AVI Publishing Inc. Westport, USA (1976)
6. G.H.Weiss: *Poultry Processing* Noyes Data Corporation, New Jersey, USA (1971)
7. G Mead (Editor): *Poultry meat processing and quality* Woodhead Publishing Limited (2004)
8. T.K.Govindan: *Fish Processing Technology* Oxford and IBH Publishers, New Delhi (1985)
9. F.W. Wheaton and T. B. Lawson: *Processing of Aquatic Food Products* John Wiley and Sons Publishers, New York (1985)

FP209 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Chemistry and Technology of Coffee
Coffee – Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the

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manufacture of coffee powder – Instant coffee, technology – Chicory chemistry - Quality grading of coffee

Unit II : Tea – Chemistry and Technology

Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and ctc – Chemistry and technology of CTC tea – Manufacturing process – Green tea manufacture – Instant tea manufacture – Grading of tea

Unit III : Chemistry and Technology of Cocoa and Cocoa Products

Occurrence – Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture
Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates

Unit IV : Chemistry and Technology of Major Spices

Pepper, Cardamom, ginger and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identicals - Quality control

Unit V : Chemistry and Technology of Minor Spices

Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Quality control
Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

Text Books / Reference books

1. Salunkhe, D.K. and Kadam S.S. Ed. 1998. *Hand book of Vegetable Science and Technology*, Marcel Dekker, New York, USA.
2. Chocolate, *Cocoa and Confectionery Technology*, Minifie Bernard W., III Edition, Aspen Publication, 1999.
3. *Handbook on Spices*, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004.

FP210 FOOD PACKAGING TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Introduction to Food Packaging:

Protection of Food products as major role of food packaging: Functions of packaging, Effect of environmental factors on food quality and shelf life, Need for protective packaging, effect of light, Oxygen, Moisture, Temperature, mechanical forces and biological factors on quality of food. Estimating the Shelf life requirement of food products for packaging, General Approach, analysis of storage requirement, accelerated storage studies: Vacuum and Inert Gas Packaging: Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

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Unit II : Metal Cans as Packaging

Merits and demerits, Metallic can types employed, Tin cans and Aluminum cans, relative merits and demerits, specialty of Open top sanitary cans (CANS), Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Relative merits and demerits. Basics of Canning operations, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used.

Unit III : Flexible Films Packaging

Relative merits and demerits. Formation of Films and pouches, Plastics used and their Specific applications, advantages and disadvantages – Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Poyvinylidene Chloride (PVDC - Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications. Co-extruded films and Laminates Their applications. Filling (Volumetric and Gravimetric) and Sealing of pouches, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging –Fabrication methods in brief –Thermo forming, Blow moulding, Injection moulding, Extrusion

Extrusion Blow moulding etc., applications: Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging and their applications.

Unit IV : Filling and Sealing Operations for various types of packages.

Can double seam, can seam formation and defects, terminology, Metal caps for bottles and jars – Crown corks, lug caps, Twist off lid and ROPP caps, Description and applications. Closing and sealing of Rigid plastic containers. Filling and sealing of Flexible plastic containers, Seal types-Bead seals, Lap Seals and Fin seals –Differences and advantages, Hot wire sealing, hot bar sealing and impulse sealing – differences and relative advantages, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements.

Unit V : Interaction of Food Material with Packaging Material

Active packaging, Moisture control, CO_2 and Oxygen scavenging, Modified atmosphere packaging – principles, applications.

Text/Reference Books

1. Gordon L. Robertson: *Food Packaging- Principles and Practice* Marcel Dekker Inc, USA (1993)
2. Donald Downing: *Complete Course in Canning (3 Volumes)* CTI Publications inc, USA (1996)
3. Mathlouthi M. (Editor): *Food Packaging and Preservation* Elsevier Applied Science Publications Essex, UK (1986)
4. Shirly V.Vangrade and Morgy Woodburn: *Food Preservation and Safety* Surabhi Publications, Jaipur India
5. J. R.D.David, R. H Graves and V.R.Carlson: *Aseptic Processing and Packaging of Foods:* CRC Press, New York
6. NIIR Board: *Food Packaging Technology Handbook* National Institute of Industrial Research, New Delhi (2004)

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7. Frank A. Paine and Heather Y.Paine: *A Hand Book of Food Packaging* Leonard Hill Publications (Blackie and sons) (1983)
8. O.G.Pirenger and A.L.Baver: Plastic Packaging Materials for Food Wiely VCH, GmbH, Germany (2000)
9. Kalman Peleg: *Produce Handling, Packaging and Distribution* AVI Publishing Company, Inc,Westport, USA (1985)
10. N.T.Crossby: Food Packaging Materials Applied Science Publishers, London, UK, (1985)
11. J Ralph Blanch Field (Ed.): *Food Labelling* Woodhead Publishing Inc. CRC Press USA (2000)
12. Irwin A.Taub, R. Paul Singh: *Food and Storage Stability* CRC Press, USA (1997)
13. David Kilcast & Persis Subramaniam: *The Stability and Shelf Life of Food* Woodhead Publishing Limited, CRC Press (2000)
14. Aaron L. Brody: *Controlled/Modified Atmosphere/Vacuum Packaging of Foods* Food And Nutrition Pres, USA (1989)
15. R.T.Parry: *Principles and Applications of Modified Atmosphere Packaging of foods*: Blackey Academic and Professional, London (1993)
16. M.L.Rooney: *Active Food Packaging* : Blackey Academic and Professional, London (1995)
17. s and L.W. Aurand: *Laboratory Manual for Food chemistry:* AVI Publishing Company Inc. USA (1977)

FP211 MILLING AND BAKERY TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Fundamentals of Market Analysis for Wheat and Wheat Products:
Laboratory testing of Wheat grain Quality, Moisture tests, Grain hardness testing. Testing of wheat flour for bread making and Chapathi making, Visco graph, Amylograph, Ferinograph and other tests and their significance in bread manufacture.

Unit II : Outline of the Wheat Milling Process
Wheat milling Flow sheet, explanation of steps in milling operations of milling; Cleaning, Sifters, Destoners, Wet Washing, Roller milling – Break rolls, fluted rolls and plane rollers and their applications, Sifting and purifying, plan sifters; Details of gradual reduction and purifying system, Extraction, extraction rates and control of extraction, milling for Atta, Semolina of different particle size, Maida and other products. Pneumatic conveying of products, By products of wheat mill, Grits and Bran, Extruded macaroni products from Wheat semolina. Wheat mill yields Energy requirement for different operations and its conservation.

Unit III : Bakery Equipment and Engineering
Bulk handling of ingredients, Weighing and metering equipment, Dough mixing and mixers, Dividing, rounding, sheeting, and laminating, Fermentation enclosures and brew equipment, Forming and molding bread-like products, Forming cookies, crackers and other products,

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Ovens and baking, Fryers and frying, Pans, pan handling equipment, and Slicers, Applicators for adjuncts, Packaging materials and equipment; Preservation methods, Computerization in plant and laboratory, Sanitation and safety.

Unit IV : Baking Technology

Bread manufacturing process – Straight dough fermentation, Sponge and dough, Accelerated processing, Chorley wood bread process, Dough retarding and freezing – Specialty fermented goods- Part-baked breads, Yeast laminated products,

Materials of Baking - Ingredients from wheat, Ingredients from other grains, Leaveners and yeast foods, Shortenings, emulsifiers and antioxidants, Sweeteners and malt syrup, Water and salt, Ingredients from milk and eggs, Fruits, vegetables, and nuts, Spices, flavors, and colors

Unit V : Biscuits and Cake Manufacture

Biscuits – Ingredients and flour specification - Types of biscuit doughs – Developed doughs, short doughs, semi-sweet, enzyme modified doughs and batters- importance of the consistency of the dough

Cake manufacture – Flour specification – ingredients – manufacturing process – types of chemically aerated goods

Text/Reference Books

1. *Association of Operative Millers Cereal Millers Hand Book*: Burgess Publishing company, USA 1963
2. Y. Pomeranz *Modern Cereal science and Technology*: MVCH Publications, NY (1987)
3. N.L.Kent, A.D.Evers *Technology of Cereals*: Peregaman Press (Elsevier Publishers) (1994)
4. Samuel A. Matz : *Bakery Technology and Engineering (3rd Edition* Published by Chapman & Hall (1992)
5. Samuel A. Matz: *Equipment for Bakers* Pan Tech International Publication (1988)
6. Stanley P Cauvain, Linda S Young: *Technology of Breadmaking*: Second Edition Aspen publication, 1999
7. Duncan Manley: *Biscuit Doughs Manual 2*, by Woodhead Publishing Ltd., England 1998.
8. A Bent, E B Bennion, G S T Bamford: *The technology of cake making*, Sixth edition, Blackie Academic and Professional, UK. 1997
9. Stanley P. Cauvein: *Bread Making – Improving Quality* Woodhead Publishing(CRC Press 2003)
10. Duncan J.R. Manley: *Technology of Biscuits, Crackers, and Cookies* Ellis Horwood Ltd (1983)

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FP212 ANALYSIS OF FOOD CONSTITUENTS – 1

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

FP213 PROCESSING OF FOOD – 1

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

FP214 ANALYSIS OF FOOD CONSTITUENTS – 2

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

FP215 FOOD ADDITIVES LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

FP216 ANALYSIS OF FOOD COMMODITIES – 1

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

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SCHOOL
OF
BIOTECHNOLOGY

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ADDITIONAL SUBJECTS

Code	Subject Name	Credit
BC209	Biochemistry	4:0:0
BC210	Bioorganic chemistry	4:0:0
BC211	Instrumental Methods of Analysis	4:0:0
BC212	Food Biochemistry & Nutrition	4:0:0
BC301	Cell Biology and Advanced Biochemistry	4:0:0
BC302	Cell Biology and Advanced Biochemistry Lab	0:0:2
BC303	Food Biochemistry and Nutrition	3:1:0
BC304	Food Biochemistry Lab	0:0:2

BC209 BIOCHEMISTRY

Credit : 4:0:0 **Marks (40+60)**

Unit - I : Structure and Properties of Carbohydrates and Lipids

Structure and properties of mono, di, oligo and polysaccharides, complex carbohydrates-Structural and functional relationships. Structure and properties of fatty acids, phospholipids, sphingolipids, glycolipids and steroids.

Unit – II : Structure and Properties of Proteins and Nucleic Acids

Structure and properties of amino acids, modified amino acids, peptides, proteins, conjugated proteins and structure-function relationship in proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, ribonucleic acids, deoxy ribonucleic acids, nucleoprotein complexes and structure-function relationship in nucleic acids.

Unit – III : Intermediary Metabolism And Bioenergetics

Overview of intermediary metabolism: Interconnections and regulation of metabolic pathways. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle.

Unit – IV : Metabolism Of Carbohydrates and Lipids

Lipid Metabolism: Biosynthesis and biodegradation of fatty acids and cholesterol.
Carbohydrate Metabolism: Glycolysis, pentose phosphate pathway, TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis. Inborn errors of metabolism.

Unit-V : Metabolism Of Proteins And Nucleic Acids

Biodegradation of proteins and nucleic acids. Biosynthesis and biodegradation of important amino acids- Leu, Thr, Met, Lys, Tyr, Phe, Trp, Glutamate and Cys-Urea Cycle, purines and pyrimidines. Inborn errors of their metabolism.

Text book:

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.

References:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.

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2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., (2000). Harper's Biochemistry, Prentice Hall International.

BC210 BIOORGANIC CHEMISTRY

Credit : 4:0:0 **Marks (40+60)**

Unit – I Concepts in organic chemistry
Stereochemistry- R, S notation, E, Z Isomerism- Mechanism of SN1 and SN2 reactions. Mechanisms of E1 and E2 reactions. Enantiomers, Optical isomers, optical activity and optical rotation-polarimeter.

Unit – II Chemistry of enzymes
Structure of atom, chemical bonding and its characteristics, Chemical bonding involved in protein structure, Specificity of enzymes. Concept of Free energy and its importance in biology. Chemistry of active oxygen species, free radicals systems.

Unit – III Case studies of enzyme structure and mechanism
Acid base and covalent catalysis**,** Stereochemistry of amino acids, Structure and mechanism of pyruvate dehydrogenase, proteases, ribonucleases, Carboxy peptidase, lysozyme. NAD, Dependent oxidation and reduction reactions,

Unit IV: Hydrolysis in chemical synthesis
Ester hydrolysis, Amide hydrolysis, peptide synthesis, structure and mechanism of FAD THF coenzymes, Application of enzymes in industry and medicine. .

UNIT V : Protein folding kinetics and folding pathways
Structure of proteins- an overview, Basic methods of protein folding – two state kinetics-multistate kinetics-in protein folding**.** Protein folding, its dynamics, stability of proteins and molecular chaperones. NMR, Circular dichorism - Principles, types, components and applications in Biology.

Text books:
1. Text- H.Dugas , Bioorganic chemistry, Springer Verlag Publishers, 1999.
2. Biochemistry by Mathew , Van Holde, Athern , Pearson Publishers Ltd, New Delhi, 2000.

References:
1. Fundamental of Biochemistry by J.L. Jain & Sunjay Jain, 6th Edition, 2004.
2. Organic chemistry by paula yurkaris Bruice, 3rd edition, Pearson P Ltd, New Delhi; 2002.
3. Trevor Palmer, Enzymes, East West Press P Ltd, New Delhi, 2005.

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BC211 INSTRUMENTAL METHODS OF ANALYSIS

Credit : 4:0:0 **Marks (40+60)**

UNIT I Buffer Solutions
Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H_2 electrode and glass electrode. calibration of instrumental methods, signal to noise ratio.

UNIT II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer
Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

UNIT III Chromatography and Electrophoresis
Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC. Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis, isotachophoresis, supporting materials-paper, starch, agarose, polyacrylamide.

UNIT IV Radio active techniques
Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Autoradiography, Applications in Medicine & Diagnosis.

UNIT V Thermo Analytical Techniques
Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC)

Text Book

1. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 1992.
2. Instrumental Methods of Analysis, D. Skoog, 2000.

Reference Books:

1. Ewing GW, Instrumental methods of Chemical Analysis, McGraw Hill Book Company, 1989.
2. Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987.

BC212 FOOD BIOCHEMISTRY AND NUTRITION

Credit : 4:0:0 **Marks: 40 + 60**

Unit I
Electron transport chain - glycolysis, TCA cycle, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof Pathway (EMP), urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

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Unit II

Biosyntheses and degradation of fatty acids, and cholesterol - Biosyntheses and degradation of amino acids (one example each for sulphur containing, aliphatic, aromatic, heterocyclic, basic and acidic amino acids), peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids.

Unit III

Basic concept of nutrition – Importance of nutrition and dietetics - Assessment of nutritional status – energy value of carbohydrates, proteins and fats – determination of energy value – balanced diet – Recommended dietary intake – Acceptable dietary intake – Protein efficiency ratio – Net protein utilisation and their determinations – Malnutrition and its problems – Nutrient supplementation – fortification - Nutritional labeling and its importance - Effect of processing on protein quality, essential amino acids - Digestibility, carbohydrates in food and dietary fibre

Unit IV

Inborn errors of carbohydrate, protein and fat metabolisms - Nutrition and disorders associated with organs such as liver and kidney - Naturally occurring anti-nutritional factors – Cyanogens, lectins, enzyme inhibitors, phytoallexins, phytates

Unit V

Nutrition for specialized purposes – Pediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods. Ageing –Theories of ageing – Nutrition and ageing – Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, alzheimer's disease

Text / Reference Books:

1. Lehninger A.L, Nelson D.L., M.M. Cox, Principles of Biochemistry, CBS Publications, 1993.
2. Voet D, Voet G, Biochemistry, Second Edition, John Wiley and Sons, 1994.
3. Food and Nutrition, Wahlquist M L, 1997

Reference Books

1. Stryer L, Biochemistry, Fouth edition, 1994.
2. Principles of Human nutrition – Second Edition, Edited by Martin Eastwood, Blackwell Publishing
3. Functional foods and Nutraceuticals in Cancer Prevention, Edited by Ronald Ross Watson

BC301 CELL BIOLOGY AND ADVANCED BIOCHEMISTRY

Credit: 4:0:0 **Marks: (40+60)**

UNIT I Structure, Function and Transport Mechanisms of the Cell

Structure and function of Eukaryotic and prokaryotic cells- it's membrane- Micelles- different types of proteins & extra cellular matrix. Transport in eukaryotic cells-Passive &

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active transport, trans-membrane potential coupled ATP generation, endocytosis and exocytosis. Transport into prokaryotic cells-group transportation. Entry of virus and toxins into cells.

UNIT II Cell-Cell Signalling and Apoptosis

Receptors - endocrine models of action- signal amplification. Different models of signal transduction-signalling by protein kinases-serine/threonine kinase –tyrosine kinase-MAP kinases. Cell cycle –it's control molecules & mechanism-apoptosis-oncogenes.

UNIT III Introduction to Biomolecules

Biomolecules: Occurrence, classification, structure, properties and functions of carbohydrates, proteins, lipids and vitamins. stabilization of proteins and nucleic acids. Structural and functional relationships in complex carbohydrates, proteins and nucleic acids.

UNIT IV Enzymes

Enzymes-action, specificity, classification, structure, properties and function of enzymes. Enzyme kinetics: Michales- Menton equation, enzyme inhibition, kinetics of competitive, non – competitive and mixed inhibitors, allosterism, application of enzymes.

UNIT V Metabolic Pathways and Bioenergetics

Energy yielding biochemical pathways: Biodegradation of amino acids, fatty acids, cholesterol, purines and pyrimidines. Glycolysis, TCA cycle, pentose phosphate pathway. Bioenergetics: Redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle.

Text Book

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.
2. Darnell J, Lodish H, Baltimore D, Molecular Cell Biology, W.H.Freeman (2002), Fourth edition.

Reference Books

1. Harper's Biochemistry – (2000), Robert K., Md Murray,Daryl K. Granner,Peter A. Mayes, Victor W. Rodwell,Appleton and Lange, Robert K. Murray
2. Donald Voet and Judith G. Voet .Biochemistry – Volume 1 Biomolecules, Mechanisms of Enzyme Action, & Metabolism; 2004.
3. A Text Book of Biotechnology by B. N. Prasad (2003), Budha Academic Publishers Pv.Ltd.G. P.O.Box 20195 Kathmandu,Nepal

BC302 CELL BIOLOGY AND ADVANCED BIOCHEMISTRY LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

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BC303 FOOD BIOCHEMISTRY AND NUTRITION

Credit : 3:1:0 **Marks: 40 + 60**

Unit I:
Electron transport chain - glycolysis, TCA cycle, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof Pathway (EMP), urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

Unit II:
Biosyntheses and degradation of fatty acids, and cholesterol - Biosyntheses and degradation of amino acids (one example each for sulphur containing, aliphatic, aromatic, heterocyclic, basic and acidic amino acids), peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids.

Unit III:
Basic concept of nutrition – Importance of nutrition and dietetics - Assessment of nutritional status – energy value of carbohydrates, proteins and fats – determination of energy value – balanced diet – Recommended dietary intake – Acceptable dietary intake – Protein efficiency ratio – Net protein utilisation and their determinations – Malnutrition and its problems – Nutrient supplementation – fortification - Nutritional labeling and its importance - Effect of processing on protein quality, essential amino acids - Digestibility, carbohydrates in food and dietary fibre

Unit IV:
Inborn errors of carbohydrate, protein and fat metabolisms - Nutrition and disorders associated with organs such as liver and kidney - Naturally occurring anti-nutritional factors – Cyanogens, lectins, enzyme inhibitors, phytoallexins, phytates

Unit V:
Nutrition for specialized purposes – Pediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods
Ageing –Theories of ageing – Nutrition and ageing – Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, alzheimer's disease

Text Books:

1. Lehninger A.L, Nelson D.L., M.M. Cox, Principles of Biochemistry, CBS Publications, 1993.
2. Voet D, Voet G, Biochemistry, Second Edition, John Wiley and Sons, 1994.
3. Food and Nutrition, Wahlquist M L, 1997

Reference Books:

4. Stryer L, Biochemistry, Fouth edition, 1994.
5. Principles of Human nutrition – Second Edition, Edited by Martin Eastwood, Blackwell Publishing
6. Functional foods and Nutraceuticals in Cancer Prevention, Edited by Ronald Ross Watson

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BC304 FOOD BIOCHEMISTRY LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

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ADDITIONAL SUBJECTS

Code	Subject Name	Credit
MB301	Microbial Biotechnology	4:0:0
MB302	Microbial Biotechnology Lab	0:0:2
MB303	Molecular Biology and Genetics	4:0:0
MB304	Food Microbiology	3:1:0
MB305	Food Microbiology Lab	0:0:2

MB301 MICROBIAL BIOTECHNOLOGY

Credit: 4:0:0 **Marks: (40+60)**

Unit- I Introduction to Microbiology

Basic of microbial existence: history of microbiology, classification and nomenclature of microorganism. Structural organization and multiplication of bacteria, viruses, algae and fungi. Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bacteria.

Unit- II Industrial and Environmental Microbiology

Primary metabolites; secondary metabolites and their applications; Biopreservation of food; production of penicillin and alcohol, Mycotoxin, bioremediation, biofertilizers: rhizobia, cyanobacteria, production of cyanobacterial inocula, *Azolla- Anabaena* symbiosis, production of *Azolla, Azospirillum, Azotobacter*, mycorrhizae (AMFungi), biopesticides and biosensors.

UNIT III Microbial Growth, Kinetics, Maintenance and Product Formation

Phases of cell growth in batch cultures; simple unstructured kinetic models for microbial growth; substrate utilization and product formation, growth associated and non - growth associated product formation kinetics; Monod and Leudeking – Piret models: Monod's model including the effects of inhibition, determination of kinetic parameters by batch, fed batch and continuous culture and analysis of chemo state performance. Role of maintenance and endogenous metabolism in substrate utilization and growth.

Unit- IV Structured Models for Growth and Product Formation

Introduction to structured models for growth and product formation. Compartmental & metabolic models; product formation kinetics: Gaden's and Deindoerfer's classifications, chemically & genetically structured models; kinetics of growth & product formation by filamentous organisms. Considerations for the production of r- DNA products.

Unit- V Analysis of ideal bioreactors

Chronological development of industrial microbial biotechnology Range of products, Components of a microbial bioprocess. The Ideal Batch reactor, Continuous Stirred Tank Reactor (CSTR), series of CSTRs, Fed- Batch and Plug flow Reactors, packed bed reactors, fluidized bed reactors& membrane bioreactors.

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Text Books:

1. Pelczar MJ, Chan ECS And Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India; 2001.
2. Biochemical Engineering fundamentals by J E Bailey and D F Ollis, 2nd ed, McGraw-Hill (1986).
3. Principles of fermentation technology by P F STANBURY, A. WHITAKER, S. Hall, Butterworth-Heinemann; 2 edition, 1999.

Reference Books:

1. Principles of Cell Energetics: BIOTOL series, Butterworth- Heinemann; 1993.
2. Bioprocess Technology- Kinetics & Reactors by A Moser, Springer, Rev&Expand edition, 1988.
3. Biochemical Engineering and Biotechnology Handbook by B. Atkinson & F.
4. Mavituna, 2nd Ed. Stockton Press (1991).

MB302 MICROBIAL BIOTECHNOLOGY LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

MB303 MOLECULAR BIOLOGY AND GENETICS

Credit : 4:0:0 **Marks (40+60)**

Unit I: Classical Genetics

Different forms of DNA, Mendelian genetics, linkage, crossing over, Mutations – chemical and physical mutagens – DNA damage and repair mechanisms, recombinations, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation. Lytic and lysogeny

Unit II: DNA Replication

Replication in prokaryotes and eukaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes, DNA mutation and repair.

Unit III: Transcription

Prokaryotic and eukaryotic transcription, features of promoters and enhancers, transcription factors, inhibitors, post-transcriptional modification - RNA splicing, ribozyme. RNA editing. RNA interference in medical applications

Unit IV: Translation and Regulation of Gene Expression

Elucidation of genetic code, process of translation in prokaryotes and eukaryotes, suppressor mutation, post-translational modifications, inhibitors of protein synthesis. Regulation at various stages of gene expression in eukaryotes and prokaryotes - Lac and trp operons.

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Unit V: Recombinant DNA technology
Cloning – vectors – plasmids – cosmids – restriction enzymes – steps in cloning – genomic and cDNA library – gene amplification using PCR, Agarose gel electrophoresis in DNA separation, Advances in genetic engineering methods and applications.

Text Books

1. David Friefelder, Molecular Biology, Narosa Publ. House. 1999
2. Gardner / Simmons / Snustad, Principles of Genetics, Eighth Edition, John Wiley

Reference books

1. Benjamin Lewin, Gene VII, Oxford University Press. 2000
2. Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM,. Molecular Biology of the Gene. 1987

MB304 FOOD MICROBIOLOGY

Credit : 3:1:0 **Marks: 40 + 60**

Unit I: Introduction and Methodology
Micro organisms associated with foods: Bacteria – Beneficial and Contaminants Molds, Viruses; Definitions, Intestinal viruses, Bacterial viruses and Fungal Viruses - Factors affecting their growth – Recent developments - antimicrobial barriers and constituents.

Methods of screening, isolation and enumeration of microorganisms - Recent developments – Direct Epifluorescent Techniques, Hydrophobic grid membrane filter, Thermostable nuclease test, Dye-reduction tests, electrical methods, ATP determination – Rapid methods for the detection of specific organisms and toxins – Limulus lysate for endotoxins, Immunological methods – Serotyping, and DNA/RNA methodology.

Unit II: Conventional methods of preservation
Thermal mode of preservation – Pasteurisation and appertization – determination of D and z values – spoilage of canned foods – aseptic packaging - Low-temperature storage
Non-thermal methods of preservation
High pressure processing – Pascalisation - Irradiation – Brief account of microwave, UV and ionizing radiation - Use of chemical preservatives, Natural food preservatives - Microbiological quality control and HACCP

Unit III: Microbiology of Food commodities of plant origin
Cereals, Pulses, Nuts and Oilseeds, Fruits and Fruit products, Vegetables and Vegetable products - Traditional vegetable fermentation – Sauerkraut, Lactic acid fermentation – Recent developments in cereal-based lactic acid fermentations

Unit IV: Microbiology of Food commodities of animal / marine origin
Fresh meat and poultry, Eggs, Processed meat and sea foods, Dairy products - Dairy fermentations – Importance of Lactic acid bacteria, Lantibiotics

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Unit V : Food borne pathogens

Aeromonas hydrophila, Bacillus cereus, Brucella, Camphylobacter, Clostridium botulinum, Escherichia coli, Salmonella, Staphylococcus aureus, Scombrotic fish poisoning, Hepatatis A and E, Gastroenteritis viruses, Spongiform encephaolpathies

Text Books

1. W.C.Frazier: Food Microbiology (II edition or later) Mcgraw Hill Book Company, New York (1968)
2. M.R. Adams and M.O. Moss, Food Microbiology Second Edition Panima Publishing corporation, New Delhi. Third reprint 2004

References:

1. Gustavo F Gutierrez-Lopez, Gustavo V Barbosa-Canovas Food Science and Food Biotechnology: CRC Press 2003.
2. Jay J.M., Loessner M.J. and Golden D.A., Modern Food Microbiology, Seventh Edition, Springer, USA, 2005.
3. Bibek Ray: Fundamental Food Microbiology, (Third Edition) CRC Press December 2003.

MB305 FOOD MICROBIOLOGY LAB

Credit : 0:0:2 **Marks: 50 + 50**

12 experiments will be notified by the HOD from time to time

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ADDITIONAL SUBJECTS

Code	Subject Name	Credit
CL211	Fundamentals of Thermal Fluid Sciences	4:0:0
CL212	Unit Operations of Chemical Engineering	4:0:0
CL213	Process Economics and Plant Design for Food Engineers	4:0:0
CL214	Biochemical Engineering	3:1:0
CL215	Fundamentals of Thermal Fluid Sciences for Food Engineers	4:0:0
CL216	Economics and Food Industry Management	3:1:0
CL301	Biochemical Engineering	4:0:0
CL302	Biochemical Engineering Lab	0:0:2

CL211 FUNDAMENTALS OF THERMAL FLUID SCIENCES

Credit : 4:0:0 **Marks (40+60)**

UNIT – I: Fluid Mechanics:

Fluids-Properties, Vapour pressure, surface tension, capillary effect. Pressure, Temperature; Types of fluids. Bernoulli equation; Fluid flow- laminar, turbulent; pressure drops in pipes (Simple problems in incompressible fluids).

UNIT – II: Introduction to thermodynamics

Thermodynamic system and Control volume, thermodynamic Properties, Thermodynamic equilibrium, thermodynamic process, Zeroth law of thermodynamics, concept of work and heat transfer. First law of thermodynamics –closed and open system, SFEE. Equation of state-ideal gas. Second law of thermodynamics. Properties of steam, dryness fraction, sensible heat, latent heat. (Simple problems in SFEE).

UNIT – III: Heat Transfer – Fundamentals:

Modes of heat transfer –Conduction, Convection and Radiation. Steady state conduction. Introduction to convection -Forced and natural. Introduction to Radiative heat transfer (Derivation not required-Simple problems).

UNIT - IV: Heat Transfer with phase change:

Boiling and condensation; Basic concepts multiphase flow; Pool boiling, Flow boiling. (Simple problems).

UNIT – V: Heat Exchangers:

Equipments-Types; overall heat transfer coefficients; Analysis of Heat Exchangers, LMTD, NTU. Shell and tube condensers, evaporators- single and multiple effects, mass and enthalpy balances. (Simple problems).

Text Book:

1. Yunus A.Cengel, Robert H.Turner.," Fundamentals of Thermal Fluid Science", Tata McGraw Hill,New Delhi,2005.
2. Arora, S.Domkundwar; A course in heat and mass transfer-Dhanpat rai & Co. Ltd,

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2002.

Reference Books:

1. R.K. Bansal, "A Text book of fluid Mechanics & Hydraulic Machines", Laxmi Publications (1992).
2. Kothandaraman,C,P., et al, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 3rd Edition, 1993.
3. Incropera F.P. Fundamentals Of Heat And Mass Transfer, John Wiley.1998.

CL212 UNIT OPERATIONS OF CHEMICAL ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Overview of Process Engineering

Mass and energy conservation; process automation; environment; applied mathematics for experimental curve fitting; numerical differentiation; integration.

UNIT – II Material Balances

Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; unit operations; recycle and by pass; humidity calculations.

UNIT – I Mixing and Agitation

Agitation of liquids; circulation, Velocities and power for agitation; gas-liquid systems; gas-solid suspensions;

UNIT – V Flow Through Packed Columns

Fluidisation-Drag force, coefficents; Friction in flow through beds of solids, Mechanics of particle motion, Terminal velocity, Motion of spherical particle. Minimum fluidization velocity

UNIT – II Filtration

Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation.

Text Book:

1. McCabe W.L., Smith J.C, Harriot P. Unit Operations In Chemical Engineering, 5th Edition. McGraw-Hill Inc., 1993.
2. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering- Vol 2 Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.

Reference Books:

1. Geankoplis C.J. Transport Processes And Unit Operations, Prentice Hall India,2002.
2. Bhatt B.I., Vora S.M. Stoichiometry,3rd Edition. Tata McGraw-Hill, 1977.
3. Albert Ebarz: Unit Operations in food Processing, CRC Press

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CL213 PROCESS ECONOMICS AND PLANT DESIGN FOR FOOD ENGINEERS

Credits : 4:0:0 **Marks (40 + 60)**

Unit I Food Process Design Development

Technical feasibility survey of Food Industry, process development, Food Process flow sheets – Hygienic food process design - equipment design and specifications – Computed-aided process design – Principles of spread-sheet aided process design (Basic concepts only)

Unit II General design Consideration

Marketability of the product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, govt, regualtions and other legal restrictions, community factors and other factors affecting investment and production costs.

Unit III Project evaluation and Cost Estimation

Capital investments – fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investments. Manufacturing costs – Direct production costs(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitablity - Application to a Food Processing plant e.g. Tomato processing

Unit IV Plant overheads

Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc

Unit V Profitability Analysis

Return on original investment, interest rate of return, accounting for uncertainty and variations and future developments. Optimization techniques – Linear and Dynamics programming, Optimization strategies.

Text Book

1. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 4th Edition, 1989.
2. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc., 2003.

Reference Book

1. Rudd and Watson, Strategy of Process Engineering, Wiley, 1987.

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CL214 BIOCHEMICAL ENGINEERING

Credits : 3:1:0 **Marks (40 + 60)**

Unit I Fermentation Kinetics

Fermentation mechanisms and kinetics: kinetic models of microbial growth and product formation Stoichiometry, Reaction rates, Yields; Fermenter types; Modeling of batch and continuous Fermenter

Unit II Bioreactor design

Mixing phenomena in bioreactors. Sterilization of media and air, sterilization equipment, batch and continuous sterilize design. Biochemical product recovery and separation. Stirred tank reactors, tank design, agitators, Foil, Paddle and Helical agitators and characteristics; Air lift Reactors and packed reactors; Basics of design of reactors, basics of Modelling and Scale-up.

Unit III Down stream processing operations

Solid -Liquid and Liquid-Liquid Separation processes, Extraction, Micro Filtration membrane filtration and centrifugal separation techniques, Chromatographic techniques for separation, Drying of products; Bio process control and control instrumentation.

Unit IV Industrial production of important products

Production of Pectic Enzymes-sub merged fermentation and semisolid fermentation techniques: Industrial production of Glucose transforming enzymes; Organisms involved, production, purification and immobilization of (a) Glucose isomerase and (b) Glucose Oxidase. Industrial scale Production of Bakers' yeast and Brewer's yeast; Microbial oil production and Bio pesticides.

Unit V Biosensors

Definitions, immobilization and membranes, transducer combinations; Biosensor development and diversification, Conducto-metric biosensors, Direct Electron transfer biosensors and Optic biosensors, Practical forms of Biosensors, specific applications of biosensors.

Text Books

1. J.E. Bailey and D.F. Ollis: Biochemical Engineering Fundamentals, 2nd Edition, McGraw-Hill, 1986.
2. M. El-Mansi and Charlie Bryce: *Fermentation Microbiology and Biotechnology,* Taylor and Francis Publications, London (2004)
3. M.L.Shuler & F. Kargi: *Bioprocess Engineering – Basic Concepts,* Prentice Hall (Second Edition 2002)

Reference Books

1. H.W. Blanch and D.S. Clark,*:* Biochemical Engineering, Marcel-Dekker, 1996
2. Fersht : Enzyme Structure and Mechanism, 2nd Edition, Freeman Press, 1985
3. William M Fogarty: *Microbial Enzymes and Biochemistr,* Applied Science Publishers, London (1983)
4. H. Braur: *Bio Technology (Vol-2; Fundamentals of Biochemical Engineering)* VCH Publications (1980).

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5. Tarun K. Ghose: *Bioprocess Computations in Biotechnology (Vol.1)* Ellies Horwood Limited, London (1990)
6. V.K.Joshi and Ashok Pande: *Bio Technology: Food Fermentations (Vol. I and II)* Educational Publications and Distributors, New Delhi (1999)
7. J.W.James: *Bio Process Technology: Modelling and Transport Phenomenon,* Butterworth Heinemann limited, Oxford, (1992)
8. Bjorn K. Lyderson, Nancy A. D'elia and Kim L. Nelson, *Bio Process Engineering:* Wiley International Publications, New York (1994)
9. A.O. Scott: *Bio Sensors for Food Analysis*, Royal Society of Chemistry, UK (1998)
10. A.E.G.Cass: *Bio Sensors – A Practical Approach*, Oxford University Press, UK, (1990)

CL215 FUNDAMENTALS OF THERMAL FLUID SCIENCES FOR FOOD ENGINEERS

Credit: 3:1:0 **Marks:40+60**

UNIT I: Introduction to Fluid Mechanics:
Fluids-Properties, Vapour pressure, surface tension, capillary effect; Types of fluids. Bernoulli equation; Fluid flow- laminar, turbulent; pressure drops in pipes, valves and bends. Orificemeter, Venturimeter, Rotameter, Pitot tube-working principles only.(Simple calculations).

UNIT II: Introduction to thermodynamics
Thermodynamic system and Control volume, thermodynamic Properties, Thermodynamic equilibrium, thermodynamic process, Zeroth law of thermodynamics, concept of work and heat transfer. First law of thermodynamics –closed and open system, SFEE. Equation of state-ideal gas. Second law of thermodynamics. Properties of steam, dryness fraction, sensible heat, latent heat. (Simple problems in SFEE).

UNIT III: Heat Transfer – Conduction
Modes of heat transfer –Conduction, Convection and Radiation. Steady heat conduction in simple geometries – Plane wall, cylindrical wall without heat generation. Transient heat conduction – Lumped capacitance method for bodies of infinite thermal conductivity Theory of insulation, critical radius of insulation Overall heat transfer coefficient (Derivation not required-Simple problems).

Unit IV: Heat Transfer – Convection and Radiation:
Convection heat transfer – forced and natural; Evaluation of convection heat transfer coefficient, turbulent flow over a flat plate, Forced convection inside tubes, heat transfer coefficient for Laminar flow in a tube with constant heat flux and constant wall temperature. Basics of Radiation heat transfer. (Derivation not required-Simple problems).

UNIT V: Heat Transfer with phase change:
Boiling and condensation; Basic concepts multiphase flow; Pool boiling, Flow boiling. (Simple problems).

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Text Book:

1. Yunus A.Cengel, Robert H.Turner.," Fundamentals of Thermal Fluid Science", TaTA McGraw Hill,New Delhi,2005.

Reference Books:

1. R.K. Bansal, "A Text book of fluid Mechanics & Hydraulic Machines", Laxmi Publications (1992).
2. Kothandaraman,C,P., et al, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 3rd Edition, 1993.
3. Heat Transfer by P.K. Nag, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.

CL216 ECONOMICS AND FOOD INDUSTRY MANAGEMENT

Credit 3:1:0 **Marks (40 + 60)**

Unit I Profiles of Food Processing Industries in India

Industrial production and growth rate in food processing sector, Opportunities and Threats; Entrepreneurship; Concept/Meaning, Need, Competencies/qualities of an entrepreneur; Entrepreneurial Support System; District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC), Khadi Village and Industries Commission (KVIC), other relevant institutions /organizations/NGOs at State level

Market Survey and Opportunity Identification (Business Planning)

How to start a small scale industry, Procedures for registration of small scale industry, List of items reserved for exclusive manufacture in small scale industry, Assessment of demand and supply in potential areas of growth, Considerations in product selection, Data collection for setting up small ventures, Project Report Preparation , Preliminary Project Report, Techno-Economic feasibility report

Project Viability, Managerial Aspects of Small Business

Unit II Principles of Management

Definition, functions of management viz. planning, organization, coordination and control, Operational Aspects of Production, Inventory Management, Personnel Management, Importance of Communication in business Legal Aspects of Small Business, Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules

Unit III Factory Act and Payment of Wages Act

Environmental considerations, Concept of ecology and environment, Factors contributing to Air, Water, Noise pollution, Air, water and noise pollution standards and control; Personal Protection Equipment (PPEs) for safety at work places, Human relations and performance in organization, Industrial Relations and Disputes

Unit IV Preparation Of Financial Statements

Classification of accounts, double book entry: Financial analysis, Significance and limitations of financial statements, Financial statement analysis, Ratio analysis, Profitability,

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Solvency and activity ratios, Fund flow statements, Working capital and changes in working capital, preparation of cash flow statements, Significance of fund flow and cash flow statements.

Unit VI Project And Product Costing

Elements of costing, preparation of cost sheets, Budgeting and budgetary controls, Product costing, Break even and sensitivity analysis, rates of returns. Capital costing, pay back periods, discounted cash flow analysis, Depreciation analysis. Related financial skills

Text/Reference Books

1. Reddy P.N. and Appannaiah H.R, Management Accounting
2. BS Rathore and Dr JS Saini Aapga (Editors): *A Handbook of Entrepreneurship*, Panchkula Publications, (Haryana)
3. CB Gupta and P Srinivasan,: *Entrepreneurship Development*, Sultan Chand and Sons, New Delhi
4. Sharma BR: *Environmental and Pollution Awareness*, Satya Prakashan , New Delhi
5. Philip Kotler: *Marketing Management*, Prentice Hall of India, New Delhi

CL301 BIOCHEMICAL ENGINEERING

Credit: 4:0:0 **Marks: (40+60)**

UNIT I Overview of Fermentation Processes

General requirements of fermentation Industry, Basic design and construction of a Fermentor and its ancillaries; Materials of construction, Vessel Geometry, Flow Measuring Devices, valves (Basic construction features)

UNIT II Media Design and Sterilization for Fermentation processes

Medium requirements for fermentation processes, examples of simple and complex media, Design and usage of commercial media for industrial fermentations. Thermal death kinetics of microorganisms; Batch and continuous Heat- Sterilization of Liquid Media; Filter Sterilization of liquid Media and air sterilization, radiation and chemical sterilization. Sterilization equipment – batch and continuous.

UNIT III Metabolic Stoichiometry and Bioenergetics

Thermodynamics, mass and energy balances in microbial metabolism, cell growth and product formation; metabolic heat generation. Stoichiometry of Cell growth and product formation - elemental balances, available – electron balances, degrees of reduction of substrate and biomass; yield coefficients of biomass and product formation; maintenance coefficients; oxygen consumption and heat evolution in aerobic cultures.

UNIT IV Transport phenomena in bioreactors

Mass transfer in heterogeneous biochemical reaction system: Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer coefficients (kla); role of aeration and agitation in oxygen transfer. Heat transfer processes in biological system.

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UNIT V Process design and operation of Bioreactors

Operational modes of reactors – batch, continuous, fed batch, repetitive batch, recycle and continuous cultivation; novel bioreactors: Stirred tank, air lift and loop reactor, packed – bed and hollow – fibre membrane bioreactors; reactors for waste – treatment processes; scale- up criteria for bioreactors.

Text Books:

1. Bailey J.E. and Ollis, D.F. Biochemical Engineering Fundamentals, McGraw Hill, (1986).
2. Shule and Kargi, Bioprocess engineering, Prentice Hall, Second Indian Reprint (2004).

References:

1. Karl Schugerl, Bioreaction Engineering (Volume 1), John Wiley (1987).
2. T.K. Ghose (Ed.), Process Computations in Biotechnology, Tata – McGraw Hill, (1994).
3. Atkinson, B. & Mavituna . F., Biochemical Engineering and Biotechnology Handbook, McGraw Hill (2nd Edition) (1993).
4. H.J. Rehm and G. Reed (Ed.), Biotechnology(Vol. 3, Bioprocessing), VCH (1993)
5. Harvey W. Blanch and Duoglas S. Clark, Biochemical Engineering, Marcel Dekker Inc.(1997)
6. Pauline Doran, Bioprocess Engineering Calculation, Academic Press, 1995

CL302 BIOCHEMICAL ENGINEERING LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

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ADDITIONAL SUBJECTS

Code	Subject Name	Credit
BI210	Neurobiology and Cognitive Science	4:0:0
BI211	Nanobiotechnology	4:0:0
BI212	Neural Networks in Bioinformatics	4:0:0
BI213	Advanced Immunology	4:0:0
BI214	Molecular Modeling Lab	0:0:2
BI215	QSAR & Drug Designing lab	0:0:2
BI301	Advanced Bioinformatics	4:0:0
BI302	Advanced Bioinformatics Lab	0:0:2
BI303	Advanced Computer Programming	4:0:0
BI304	Biological Sequence Analysis and Phylogeny	4:0:0
BI305	Structural Bioinformatics	4:0:0
BI306	Genomics and Proteomics	4:0:0
BI307	Molecular Modeling & Drug Design	4:0:0
BI308	Advanced programming in Bioinformatics	3:1:0
BI309	Molecular Modeling/QSAR/Structure Based Drug Design	0:0:2
BI310	Biological Databases & Analysis Lab	0:0:2
BI311	PERL Lab	0:0:2
BI312	Biological Sequence Analysis Lab	0:0:2
BI313	Advanced Protein Engineering Technology	4:0:0
BI314	Enzyme and Metabolic Engineering	4:0:0
BI315	Computational Biology	4:0:0
BI316	System Biology and Simulations	4:0:0
BI317	Immunology and Immunotechnology	4:0:0
BI318	Bioinformatics and Computing	4:0:0
BI319	Structural Genomics and Proteome Analysis	4:0:0
BI320	C & C++ Programming Lab	0:0:2
BI321	Advanced Programming In Bioinformatics Lab	0:0:2

BI210 NEUROBIOLOGY AND COGNITIVE SCIENCE

Credits: 4:0:0 **Marks (40+ 60)**

Unit I: Introduction to Nervous System
Central and Peripheral nervous systems

Unit II: Neuro Anatomy
Structure and functions of neurons, synapse, their function, signals produced by neurons, Sensors function, Glial cells, molecular and cellular organisation of neuronal differentiation, characterization of neuronal cells.

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Unit III: Neurophysiology and Neuropharmacology
Pharmaceutical mediator released by neurons, Hormones and their effect on neuronal function, Conduction of impulses by neurons, Correlation of sensory functions.

Unit IV: Neurological Disorders
Pathogenesis, Genetic basis of neurological disorders

Unit V: Behaviour Science
Neuronal mechanism of behaviour, Animal behaviour, Behaviour in various environments.

Text Books:

1. A.B. Schiebel, Neurobiology of higher cognetive function Guilford Press 1990.
2. Haynes, Neuron in Tissue Culture, 1998.
3. Beadle, Progress in Neuropharmacology and Neurotoxicology of pesticides and drugs, 1999.

BI211 NANOBIOTECHNOLOGY

Credits: 4:0:0 **Marks: (40 + 60)**

UNIT – I
Overview and History of Nanotechnology – Generations of nanotechnology - Nanoparticles / Nanomaterials - Journals of Nanotechnology – Challenges of Nanotechnology – Applications of Nanotechnology – National and International Nanotechnology centers – Current and Future Research in Nanotechnology – Patent in Nanotechnology

UNIT - II
Molecular Manufacturing – Nano simulation; Is nanotechnology bad or good? - Implications of nanotechnology: Health and safety implications from nanoparticles: Health issues - Environmental issues - Need for regulation - Societal implications: Possible military applications - Potential benefits and risks for developing countries - Intellectual property issues - Criticism of Nanotechnology - Studies on the implications of Nanotechnology

UNIT - III
Introduction to physics of the solid state: Structure – energy bands – Localized particles; Methods of measuring properties: Atomic structure – Particle size determination – Surface structure; Properties of Individual Nanoparticles: Metal Nanoclusters – Semiconducting nanoparticles – Rare Gas and Molecular Clusters; Carbon Nanostructures; Carbon Molecules – Carbon Clusters – Carbon Nanotubes – Applications of Carbon Nanotubes

UNIT - IV
Bulk Nanostructured materials: Solid disordered Nanostructures – Nanostructured crystals - Nanostructured Ferromagnetism; Optical and vibrational spectroscopy: Infrared Frequency Range – Luminescence – Nanostructures in Zeolite Cages; Quantum wells, Wires and Dots: Preparation of Quantum Nanostructures – Size and Dimensionality Effects – Excitons – Single Electron Tunneling – Applications – Superconductivity; Self Assembly and Catalysis

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UNIT - V

Organic Compounds and polymers: Forming and Characterizing polymers – Nanocrystals – Polymers – Supramolecular structures; Biological Materials: Biological building blocks – Nucleic Acids – Biological Nanostructures; Nanomachines and Nanodevices: Microelectrochemical systems – Nanaoelectromechanical systems – Molecular and Supramolecular switches

Reference Books

1. Introduction to Nanotechnology, Charles P. Poole Jr. and Frank J. Owens, A Wiley-Interscience puplication, India, 2003.
2. R.S. Greco, F.B.Prinz and R.L.Smith, Nanoscale Technology in Biological Systems, CRC press, 2005.
3. M. Wilson, G. Smith, K. Kannangara, M. Simmons and Burkhard Raguse, Nanotechnology: Basic Science and Emerging Technologies, CRC press, 2002.
4. Rebecca L. Johnson, Nanotechnology, Springer, 1999

BI212 NEURAL NETWORKS IN BIOINFORMATICS

Credits: 4 : 0 : 0 **Marks: (40 + 60)**

Unit I:

Neural Network Basics. - Introduction to Neural Network Elements - Neurons - Connections between Elements - Transfer Functions - Summation Operation - Thresholding Functions- Other Transfer Functions - Simple Feed-Forward Network

Unit II:

Perceptrons and Multilayer Perceptrons - Introduction to Radial Basis Functions. Training of Neural Networks.

Unit III:

Genome Informatics Applications – Design – Data Encoding and Neural Networks

Unit IV:

Applications of Neural Networks - Nucleic Acid Sequence Analysis- Protein Structure Prediction - Protein Sequence Analysis

Unit V:

Neural Networks in Drug Design - Modeling Metabolic Energy by Neural Networks

Reference books:

1. Cathy H. Wu and Jerry W. McLarty - Neural Networks and Genome Informatics - Elsevier Science., 2000
2. J. Zupan, J. Gasteiger - Neural Networks in Chemistry and Drug Design. Wiley-VCH, 2000.

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BI213 ADVANCED IMMUNOLOGY

Credits: 4 : 0 : 0 **Marks: (40 + 60)**

Unit I: Immune System

Introduction, Lymphocytes, their origin and differentiation, antigens, their structure and classification, complement and their biological functions, types of immune responses, anatomy of immune response.

Unit II: Humoral Immunity and Cellular Immunology

B-lymphocytes and their activation, structure, and function of immunoglobulin, immunoglobulin classes and subclasses, major histrocompatibility complex. Thymus derived lymphocytes (T cells) their classification, antigen presenting cells (APC), macrophages, langerhans cells, their origin and functions, mechanism of phagocytosis

Unit III: Immunity of infection and autoimmunity

Hypersensitivity reactions, mechanisms of T cell activation, cytokines and their role in immune response macrophage activation and granuloma formation., Auto antibodies in humans, pathogenic mechanism, Graft rejection, evidence and mechanisms of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease.

Unit IV: Antibodies & Immunodiagnosis

Monoclonal and polyclonal antibodies – their production and characterization, Western blot analysis, immuno electrophoresis, SDS-PAGE, purification and synthesis of antigens, ELISA-principle and applications, radio immuno assay(RIA)-principles and applications, Immunofloresecnce techniques

Unit V: Molecular Immunology

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system, production of antidiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immunotherapy with genetically engineered antibodies

Reference Books:

1. Roitt I, Essential Immunology, Blackwell Scientific Publications, Oxford, 1991.
2. Benjamin E and Leskowitz S, Immunology a Short Course, Wiley Liss, NY, 1991.
3. Kuby, Immunology, Fourth edition, Freeman, 2002.

BI214 MOLECULAR MODELLING LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

BI215 QSAR & DRUG DESIGNING LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

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BI301 ADVANCED BIOINFORMATICS

Credit: 4:0:0 **Marks: (40+60)**

Unit I: Introduction to Bioinformatics

Elementary commands and Protocols, ftp, telnet, http. Printer on information theory. Databanks – nucleotide, protein sequence and structural databases, Basic concepts of UNIX, LINUX and PERL, World wide web – search engines – finding scientific articles -Pubmed – public biological databases.

Unit II: Sequencing Alignment and Dynamic Programming

Introduction – Strings – Edit distance two strings – string similarity local alignment -gaps – Parametric sequence alignments – suboptimal alignments – multiple alignment – common multiple alignment methods. Introduction to databases – database search – Algorithms issues in database search – sequence database search – FASTA – BLAST – Amino acid substitution matrices PAM and BLOSUM.

Unit III: Evolutionary Trees and Phylogeny

Ultrasonic trees – parsimony – Ultrametric problem – Perfect phylogeny – Phylogenetic alignment – connection between multiple alignment and tree construction.

Unit IV: Biological manipulation

DNA Mapping and sequencing – Map alignment – Large scale sequencing and alignment – Shotgun – DNA sequencing – Sequence assembly – Gene predictions – Molecular predictions with DNA strings.

Unit V: Applications of Bioinformatics

New directions of bioinformatics research – essential pre-requisites - scope of Bioinformatics – useful sites – Bioinformatics in pharmaceutical industry –
Bioinformatics orientation in IT industry

Text Book

1. Dan Gusfield, Algorithms On Strings Trees And Sequences, Cambridge University Press, 1997.
2. David W Mount , Bioinformatics : Sequence and Genome analysis, 2nd edition, CBS Publishers,2004

Reference Books

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University press, 2003
2. SR Pennington, MJ Dunn, Proteomics from Protein Sequence to Function, Viva Books Ltd, 2002

BI302 ADVANCED BIOINFORMATICS LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

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BI303 ADVANCED COMPUTER PROGRAMMING

Credit : 4:0:0 **Marks (40+60)**

Unit I:

C-Language: Introduction – Operator – Expressions – Variables – Input output statements – control statements – control statements – function – arrays – pointer – structures – unions – file handling – case studies.

Unit II : Fundamentals of Object Oriented Design

Data Abstraction, Encapsulation, Classes, Inheritances and PolymorphismA first look at C++: using stream for input and output: Default Function Arguments - Placement of Variable Declaration - the Scope Resolution Operator the "Con Qualifier, Overload Function. Reference: References as Aliases - References and Pointers, Similarities - Reference as Function Parameters - Reference as Return Values

Unit III: Introduction to classes

Declaring and Using Classes - Class Members - Creation and Destruction of Objects - Accessing Data Members returning a Reference, "const" Objects and Member Function. Classes and Dynamic Memory allocation - New Deletes Operators, " this" Pointer. Array of Class Objects. Derived Class and Class Derived Constructors - Overriding Member Functions - Public and Private Inheritance - Virtual Functions – Polymorphism - Multiple Inheritance - Classes within Classes.

Unit IV: **Perl**

PERL: Modules:- defining, storing and using modules; Data and control structures:- Operators and Control Flow, Data Types & structre, Function/Subroutines - File handling; Regular Expressions:- patterns - grouping and anchoring - string matching; Object oriented programming:- Classes, Objects, Methods.

Unit V: Bioperl

General Bioperl Classes, Sequences, Sequence Manipulation, Features and Location Classes. Alignments: AlignIO. Analysis: Blast, Genscan; Databases: Database Classes, Accessing a local database.

Reference Books:

1. Herbertz Schildt, The complete Reference Java J2SE 5 Edition, Mc Graw Hill, Osborne, 2005.
2. E Balaguruswamy, Programming with Java, Tata Mc Graw Hill, New Delhi, 1999.
3. Larry Wall, Tom Christiansen & John Orwant, Programming Perl –3rd ed, O'Reilly, 2000.
4. James D. Tisdall, Beginning Perl for Bioinformatics, O'Reilly, 2001
5. Mark Lutz , Programming Python - 2nd Ed., O' Reilly, 2003.
6. Eric Ladd, J.O'Donnell, Using HTML 4, XML and JAVA, Prentice Hall of India QUE, 1999.
7. Brown, The complete reference - Perl, Tata Mc Graw Hill, New Delhi, 2004.

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BI304 BIOLOGICAL SEQUENCE ANALYSIS AND PHYLOGENY

Credit : 4:0:0 **Marks (40+60)**

Unit I:
Pairwise alignment techniques – Global alignment, Local alignment methods, Algorithm and statistics of global alignment, Algorithm and statistics of local alignment, Scoring matrices, Gap penalty, Dot matrix sequence comparison. Heuristic algorithms – FASTA and BLAST. Significance of sequence alignment.

Unit II:
Multiple sequence alignment – Goal of multiple sequence alignment to pair wise alignment, Progressive methods – CLUSTALW, PILEUP, Iterative methods – Hidden Markov models of multiple sequence alignment. Position – specific scoring matrices. Databases for the search.

Unit III:
Predictive methods: Different secondary structure prediction methods – Chou fasman method,GOR method,Algorithm behind the methods.Tools used for secondary structure prediction. Tertiary structure prediction – homology modeling tool. Description on the software package EMBOSS – programs and its usage.

Unit IV:
Predictive methods using DNA sequences. Predictive methods using protein sequences. Prediction of RNA secondary structure. Expressed sequence tags (ESTs).

Unit V:
Phylogenetic analysis – phylogenetic data analysis, Alignment – building the data model, extraction of a phylogenetic data set, Tree building method, Distance methods, maximum parsimony method, Phylogenetic software. Gene prediction methods, Genome analysis and annotation, Large-scale genome analysis and the computational tools.

Reference books:

1. Dan Graur and Wen-Hsiung Li.Fundamentals of Molecular evolution, , II ed.,Sinauer Associates, INC., 2000.
2. Roderic D. M. Page, Edward C. Holmes, Molecular evolution, A phylogenetic approach, Blackwell Science Inc; (October 1998)
3. Baxevenis, Bioinformatics, John Wiley & Sons,2002

BI305 STRUCTURAL BIOINFORMATICS

Credit : 4:0:0 **Marks (40+60)**

Unit I : Introduction
Levels of structures in Biological macromolecules - basic strategies in biophysics- Principles and concepts used in biophysical analysis of life processes - Biomolecules and their interactions, size and shape of macromolecules.

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Unit II : Conformational Analysis
Forces that determine protein and nucleic acid structure, basic problems, polypeptide chains geometrics, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions and ionic interactions, disulphide bonds.

Unit III : Structural Analysis of Macromolecules
Prediction of proteins structure, nucleic acids, general characteristics of nucleic acid structure, geometrics, glycosidic bond rotational isomers and those puckering backbone rotational isomers and ribose puckering forces stabilising ordered forms, base pairing, base stacking tertiary structure of nucleic acids.

Unit IV: Spectroscopy and methods of visualization: Absorption spectroscopy, Linear and Circular Dichroism, Emission spectroscopy, Nuclear Magnetic Resonance spectroscopy. Methods of direct visualisation, macromolecules as hydrodynamic particles, macromolecular diffusion, ultracentrifugation, viscometry.

Unit V: X–ray diffraction
X-ray crystallography – X–ray diffraction, determination of molecular structures, electron microscopy, neutron scattering, light scattering.

Text Book
1. Cantor R., Schimmel P.R., Biophysical Chemistry, Vol. I, II, W.H. Freeman & Co., 1985.

Reference Book
1. Daniel. M, Basic Biophysics for Biologists, 1998.
2. Kensal E. van Holde, W. Curtis Johnson and P. Shing Ho, Principle of Physical Biochemistry, 1998, Prentice Hall, New York.

BI306 GENOMICS AND PROTEOMICS

Credit : 4:0:0 **Marks (40+60)**

Unit I:
Overview – Concepts of central dogma- Structure & Organization of Prokaryotic & Eukaryotic genome -Variation and regulation in Prokaryotic & Eukaryotic genome expression profile– Brief outlook of various genome projects and their outcome. Nucleotide & protein sequencing methods – Chemical, enzymatic, high through put method – Automated sequencing methods

Unit II:
Various Approaches in sequencing genome – shotgun, directed short gun & Clone contig approach – Primer walking, chromosome walking, chromosome jumping, Contig assembly, Genome Marking and mapping techniques – Genomic DNA library- cDNA library

Unit III:
Mapping and sequence assembly – genetic marker – RFLP, SSLP, STRs, VNTRs – Physical Marker – EST, STS, FISH, Radiation hybrids – Sequence markers – SNPs. Expression analysis – micro array approach, Human Genome Project - Transcriptome– structural &

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functional Genomics – comparative & population genomics- Pharmacogenomics – Phylogenetics.

Unit IV:

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.

Unit V:

Proteome databases: protein sequence database, SWISS-PROT, TrEMBL, specialized protein sequence databases, PROSITE, BLOCKS, 2-D PAGE databases, PDB, genomic databases, OMIM, Metabolic databases, Some specific metabolic databases - application of proteomics to medicine, proteomics, toxicology and Pharmaceuticals

Reference:

1. T.A Brown , Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002.
2. Pennington, Proteomics from Protein Sequence to Function, 2nd edition, Viva Books Ltd, 2002
3. David W Mount, Bioinformatics: sequence and genome analysis, 2nd edition, CBS publishers, 2004

BI307 MOLECULAR MODELING AND DRUG DESIGN

Credit : 4:0:0 **Marks (40+60)**

Unit I:

Quantum mechanics and concepts in molecular modeling: Introduction – coordinate systems – potential energy surfaces – introduction to computer hardware and software – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation.

Unit II:

Molecular mechanics and energy minimization: Empirical force field models – Bond stretching – angle bending – torsional term – nonbonding interactions – thermodynamics properties using a forcefield – derived and non derived energy minimization method – simplex – sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapson method.

Unit III:

Molecular Dynamics and Monte Carto - Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carto – Random number generation – Difference in MD & MC.

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Unit IV:
Homology modeling: comparative modeling of proteins – comparison of 3D structure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.

Unit-V:
Drug design: General approach to discovery of new drugs - lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action - 3D database search – computer aided drug design – docking - molecular modeling in drug design – structure based drug design – pharmacophores - QSAR.

Text Book:

1. A.R.Leach, Molecular Modeling Principles and Application, Longman, 1996
2. R.K.Prasad, Quantum chemistry , 2002

BI308 ADVANCED PROGRAMMING IN BIOINFORMATICS

Credits: 3:1:0 **Marks: (40 + 60)**

UNIT I
JAVA - Introduction to object oriented programming - Basic Syntax - Control Structures - Arrays - Strings - Files and Streams – Applets; Introduction to JDBC (Java Database Conectivity) - JDBC Architecture, JDBC Drivers, Connecting to Database and accessing databases - Threads - Java beans.

UNIT II
JAVA - Methods and Classes : Inheritance - Packages and Interfaces - Exceptions Handling -Multithreaded Programming. I/O, - String Handling - Exploring java. lang - java.util Part 1:The Collection Framework. java.util Part2: More Utility Classes - Input/Output: Exploring java.io - Networking - The Applet Class - Event Handling

UNIT III
BIOJAVA: Introduction - Sequence Manipulation. Translation: DNA to Protein, Codon to amino acid, Six frame translation. Proteomics: mass and pI of a peptide - Sequence File Format conversions, Locations and Features. BLAST and FASTA parsing, Weight Matrices and Dynamic Programming

UNIT IV
PYTHON: Overview, Data structures, Control Flow, Modules, Basic I/O, Regular Expressions, File Manipulation, Classes, Standard library;

UNIT V
WEB DESIGNING & XML
Common Gateway Interface:- HTML form elements, GET, POST & HEAD Method, CGI Environment Variables, Handling forms, Passing Parameters via CGI, Debugging CGI programs. HTML Specifications and Syntax, XML Basics, Style Sheets, XML Applications, Java Script.

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Reference:

1. Herbertz Schildt, The complete Reference Java J2SE 5 Edition, Mc Graw Hill, Osborne, 2005.
2. E Balaguruswamy, Programming with Java, Tata Mc Graw Hill, New Delhi, 1999.
3. Larry Wall, Tom Christiansen & John Orwant, Programming Perl –3rd ed, O'Reilly, 2000.
4. James D. Tisdall, Beginning Perl for Bioinformatics, O'Reilly, 2001
5. Mark Lutz , Programming Python - 2nd Ed., O' Reilly, 2003.
6. Eric Ladd, J.O'Donnell, Using HTML 4, XML and JAVA, Prentice Hall of India QUE, 1999.
7. Brown, The complete reference - Perl, Tata Mc Graw Hill, New Delhi, 2004.

BI309 MOLECULAR MODELING/QSAR/STRUCTURE BASED DRUG DESIGN LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

BI310 BIOLOGICAL DATABASES AND ANALYSIS LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

BI311 PERL LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

BI312 BIOLOGICAL SEQUENCE ANALYSIS LAB

Credits: 0:0:2 **Marks: (50 + 50)**

12 experiments will be notified by the HOD from time to time

BI313 ADVANCED PROTEIN ENGINEERING TECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I: Introduction of proteins

Classification and properties of proteins- denaturation and coagulation of protein. Isolation, extraction and purification of proteins.

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Unit II: Amino acid sequence and conformation of proteins
Determination of amino acid composition, N-terminal and C- terminal amino acids. Amino acid sequence of proteins by chemical and enzymatic methods and finger printing technique

Unit III:
Structure of Proteins – Primary structure and its determination, secondary structure prediction and determination of supersecondary structures, protein folding pathways, tertiary structure and domain in proteins, quarternary structure, post transnational modification.

Unit IV:
Structure Function Relationship of Proteins
DNA binding proteins, prokaryotic and eukaryotic transcription factors, DNA polymerases, Membrane proteins and receptors, bacteriorhodopsin, photosynthetic centres, epidermal growth factor, insullin and PGDGF receptors and their interaction with effectors, protein phosphorylation, immunoglobulins, Nucleotide binding proteins, enzyme serine proteases, ribonuclese, lysozyme.

Unit V: Protein Engineering and Protein Design
Protein data base analysis, methods to alter primary structure of proteins, example of engineered proteins, protein design, principle and examples,

Reference Books:

1. Moody PCE, and AJ Wilkinson, Protein Engineering, IRL Press, Oxford, 1990.
2. Creighton TE, Proteins, Freeman WH, Second Edition, 1993.
3. Branden C, Tooze R, Introduction of protein structure Garland, 1993

BI314 ENZYME AND METABOLIC ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

Unit I: Mechanisms and Kinetics of Enzyme Action.
Mechanisms of Enzyme Action; Concept of active site and Energetics of enzyme substrate complex formation; Specificity of enzyme action; Kinetics of single substrate reactions; turnover number; estimation of Michaelis-Menten parameters, multi-substrate reactions-mechanisms and kinetics; Types of Inhibition-kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics.

Unit II:
Enzyme Immobilization and Mass Transfer Effects in Immobilized Enzyme System. Physical and Chemical techniques for enzyme immobilization-adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples; advantages and disadvantages of different immobilization techniques, overview of applications of immobilized enzyme systems. Analysis of Film and Pore Diffusion Effects on Kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors.

Unit III: Enzyme Biosensors and commercial applications
Applications of enzymes in analysis; Design of enzyme electrodes and their application as Biosensors in industry, health care and environment, Commercial applications of enzymes in

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food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications.

Unit IV: Metabolic engineering

Introduction to Metabolic Engineering- Metabolism -Stoichiometry, reaction rates, and dynamic mass balances -Growth Energetics.- Yield coefficients and linear rate equations - Material balances & Data consistency. Producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

UNIT - V Metabolic Engineering in Bioconversions

Metabolic bioconversion pathways, Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

Reference Books:

1. Technological applications of biocatalysts, Butterworth, BIOTOL series, 1995.
2. Cornish-Bowden, Analysis of enzyme kinetic data, Oxford Univ. Press, 1996.
3. Wiseman and N. Blakeborough and P. Dunhill, Enzymatic and Nonenzymatic Catalysis, Ex.Vol 5, Ellis and Harwood, UK, 1981.
4. A.Wiseman, Topics in enzyme and fermentation Biotechnology, Ellis and Harwood, UK Vol. 5.

BI315 COMPUTATIONAL BIOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I: Introduction to computational biology

Introduction, Biomolecular sequence analysis – Nucleic acid sequences, Motifs – localization and extraction, Protein sequence analysis and prediction of secondary structural features

Unit II: Discrete models of Biopolymers

Discretized structure models – Lattice proteins, contact graphs. Combinatorial considerations – secondary structure graphs. Random graph models of sequence structure maps, RNA secondary structures.

Unit III: Protein structure folding & prediction and DNA-Protein Interaction

Overview of protein structure, Protein folding invitro and invivo, Theoretical models of folding, Insilico folding, Protein structure prediction - Alignment based methods. DNA-Protein Interaction – Target prediction, sequence based methods, Structure based method, Ab inito method

Unit IV: Computational Genomics

Sequences and contigs, Sequence data description, Advanced Sequence data description, Genome annotation- Eukaryotic and Prokaryotic genome annotation tools. Computer simulated functions.

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Unit V: Computation in Comparative Genomics

Introduction, Evolutionary basis, Tools for comparative genomics – data selection, Alignment, Visualization

Text Book

1. Andrezej K Konopka and James C. Crabbe, Compact Handbook of Computational Biology, Marcel Dekker, USA, 2004

References

1. Joao Setubal and Joao Meidanis, Introduction to Computational Molecular Biology Publisher: PWS Publishing Company, Boston, 1997.
2. Steven Salzberg, David Searls, and Simon Kasif.Computational Methods in Molecular Biology , Publisher: Elsevier Science B.V., Amsterdam, 1998.

BI316 SYSTEM BIOLOGY AND SIMULATIONS

Credit : 4:0:0 **Marks (40+60)**

Unit I:

Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems Modeling Genetic Networks

Unit II:

Modeling the Activity of Single Gene - A Probabilistic Model of a Prokaryotic Gene and its Regulation. Modeling Biochemical Networks - Atomic-Level Simulation and Modeling of Biomacromolecules

Unit III:

Kinetic Models of Excitable Membranes and Synaptic Interactions - Stochastic Simulation of Cell Signaling Pathways -Analysis of Complex Dynamics in Cell Cycle Regulation

Unit IV:

Modeling Large Biological Systems from Functional Genomic Data: Parameter Estimation - Cellular Simulation - Towards a Virtual Biology Laboratory - Computational Cell Biology : The Stochastic Approach

Unit V:

Computer Simulation of the Whole Cell - Computer Simulation of the Cell: Human Erythrocyte Model and its Application - Software for Modeling and Simulation – E-CELL, V-CELL and GROMOS

Reference books:

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press, 2001
2. James M. Bower, Hamid Bolouri, Computational Modeling of Genetic and Biochemical Networks, MIT Press,2000.
3. Julio Collado-Vides (Editor), Ralf Hofestadt (Editor), Gene Regulation and Metabolism: Postgenomic Computational Approaches, ,MIT Press,2002

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BI317 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I: Immune System

Introduction, Lymphocytes, their origin and differentiation, antigens, their structure and classification, complement and their biological functions, types of immune responses, anatomy of immune response.

Unit II: Humoral Immunity and Cellular Immunology

B-lymphocytes and their activation, structure, and function of immunoglobulin, immunoglobulin classes and subclasses, major histrocompatibility complex. Thymus derived lymphocytes (T cells) their classification antigen presenting cells (APC), macrophages, langerhans cells, their origin and functions, mechanism of phagocytosis

Unit III: Immunity of infection and autoimmunity

Hypersensitivity reactions, mechanisms of T cell activation, cytokines and their role in immune response macrophage activation and granuloma formation., Auto antibodies in humans, pathogenic mechanism, Graft rejection, evidence and mechanisms of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease

Unit IV: Antibodies & Immunodiagnosis

Monoclonal and polyclonal antibodies – their production and characterization, western blot analysis, immuno electrophoresis, SDS-PAGE, purification and synthesis of antigens, ELISA-principle and applications, radio immuno assay(RIA)-principles and applications, Immunofloresecnce techniques

Unit V: Molecular Immunology

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system, production of antidiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immunotherapy with genetically engineered antibodies

Reference Books:

1. Roitt I, Essential Immunology, Blackwell Scientific Publications, Oxford, 1991.
2. Benjamin E and Leskowitz S, Immunology a Short Course, Wiley Liss, NY, 1991.
3. Kuby, Immunology, Fourth edition, Freeman, 2002.

BI318 BIOINFORMATICS AND COMPUTING

Credit : 4:0:0 **Marks (40+60)**

Unit I: Basics in Bioinformatics

Elementary commands and Protocols, ftp, telnet, http, WWW. Basics of computers – Servers, Operating systems – LINUX, UNIX. Databanks – nucleotide databanks — protein databanks – sequence databanks – structural databases.

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Unit II: Sequencing Alignment and Dynamic Programming
Introduction – Strings – Edit distance two strings – string similarity local alignment -gaps – Parametric sequence alignments – suboptimal alignments – multiple alignment – common multiple alignment methods. Algorithms issues in database search – FASTA – BLAST – Amino acid substitution matrices PAM and BLOSUM. HMM and ANN. GCG Sequence Analysis**.**

Unit III: Phylogeny, DNA Mapping and sequencing
Ultrasonic trees – parsimony – Ultrametric problem – Perfect phylogeny – Phylogenetic alignment – connection between multiple alignment and tree construction. DNA Mapping and sequencing – Map alignment – Large scale sequencing and alignment – Shotgun – DNA sequencing – Sequence assembly – Gene predictions – Molecular predictions with DNA strings.

Unit IV: Graph Theory and Boolean Algebra
Basic concepts – datastructure for graphs – connectivity – graph optimization. Trees – Spanning Trees – Rooted Trees – Binary Trees Boolean Algebra – Posets, Lattices – Application of Boolean Algebra to Switching theory.

Unit V: Computer Programming
Internet and Java Programming – Fundamental Programming Structure in Java – Use of Classes – Creating Packages String handling – IO streams – Applet Class. Specific applications in Biological computing. Programming strategies in PERL (Fundamentals only)

Text Books

1. Dan Gusfield, Algorithms On Strings Trees And Sequences, Cambridge University Press, 1997.
2. James Tisdal, Beginning Perl for Bioinformatics, Relly Publications, 2003
3. Arhtur M. Lesk, Introduction to Bioinformatics, Oxford University press, 2003

References

1. Baxevenis, Bioinformatics, John Wiley & Sons, 2002
2. Westhead, DR.., Parish JH and Twyman RM, Instant notes on Bioinformatics, Viva books, New Delhi, 2003
3. David W Mount, Bioinformatics: sequence and genome analysis, CBS publishers,2004
4. Seymour Lipschutz and Lipson ML, Discrete Mathematics, McGraw Hill Publications, 1992.

BI319 STRUCTURAL GENOMICS AND PROTEOME ANALYSIS

Credit : 4:0:0 **Marks (40+60)**

Unit I: Genome Sequencing
Structure & Organization of Prokaryotic & Eukaryotic genome - Nucleotide & protein sequencing methods – Chemical, enzymatic, high through put method – Automated sequencing methods – shotgun –chromosome walking, Contig assembly. Genome Mapping

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techniques –Mapping and sequence assembly – genetic marker – RFLP, SSLP, STRs, VNTRs – Physical Marker – EST, STS, FISH, Radiation hybrids – Sequence markers – SNPs. Expression analysis – micro array approach.

Unit II: Comparative Genomics

Human Genome Project - Transcriptome– structural & functional Genomics – comparative & population genomics – Pharmacogenomics..

Unit III: Proteome analysis

Proteome – Bridging Genomics and Proteomics – Analysis of Proteome – 2D PAGE – Mass spectrometry – MALDI TOF – Micro array Technology – CD. Application of Proteome analysis – Protein Chips – Drug Development and Toxicology – Proteomic in genetic and breeding. Legal aspects of Genomics & proteomics – Bioethies – IPR & Patents.

Unit IV: Protein structure elucidation

Size and shape of macromolecules, methods of direct visualisation, X-ray crystallography – X–ray diffraction, determination of molecular structures ,electron microscopy, neutron scattering, light scattering and NMR

Unit V: Structure Function Relationship of Proteins

DNA binding proteins, prokaryotic and eukaryotic transcription factors, DNA polymerases, Membrane proteins and receptors, bacterio rhodopsin, photosynthetic centres, epidermal growth factor, insullin and PGDGF receptors and their interaction with effectors, protein phosphorylation, immunoglobulins, Nucleotide binding proteins, enzyme serine proteases, ribonuclese, lysozyme.

Text Books

1. T.A Brown - Genome, II Edn, BIOS Scientific publishers Ltd., UK. 2002.
2. SR Pennington, MJ Dunn, Proteomics from Protein Sequence to Function, Viva books Ltd, 2002
3. David W Mount, Bioinformatics: sequence and genome analysis, CBS Publishers

References:

1. Creighton TE, Proteins, Freeman WH, Second Edition, 1993.
2. Cantor R., Schimmel P.R., Biophysical Chemistry, Vol. I, II, W.H. Freeman & Co., 1985.

BI320 C & C++ PROGRAMMING LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BI321 ADVANCED PROGRAMMING IN BIOINFORMATICS LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

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ADDITIONAL SUBJECTS

Code	Subject Name	Credit
BT214	Protein Engineering	4:0:0
BT215	Animal Biotechnology	4:0:0
BT216	Cancer Biology	4:0:0
BT217	Bioprocess Economics and Plant Design	4:0:0
BT218	Professional Ethics and Human Values	4:0:0
BT219	Environmental Biotechnology	4:0:0
BT220	Advanced Bioprocess Lab	0:0:2
BT221	Basic Industrial Biotechnology	4:0:0
BT301	Advances in Genetic Engineering	4:0:0
BT302	Genetic Engineering Lab	0:0:2
BT303	Advanced Bioprocess Engineering	4:0:0
BT304	Bioprocess Engineering and Downstream processing Lab	0:0:2
BT305	Metabolic Regulations and Engineering	4:0:0
BT306	Advanced Immunotechnology	4:0:0
BT307	Immunotechnology Lab	0:0:2
BT308	Plant and Animal Biotechnology	4:0:0
BT309	Environmental Biotechnology	4:0:0
BT310	Professional Ethics And Bioethics	4:0:0
BT311	Advanced Biopharmaceutiucal Technology	4:0:0
BT312	Enzyme Technology and Industrial applications	4:0:0
BT313	Research Methodology	4:0:0
BT314	Instrumentation and Biotechniques	4:0:0
BT315	Plant and Animal Biotechnology for Food Engineers	3:1:0
BT316	Metabolic Engineering	3:1:0
BT317	Downstream Processing	3:1:0

BT214 PROTEIN ENGINEERING

Credit : 4:0:0 **Marks (40+60)**

UNIT I Bonds And Energies In Protein Makeup

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II Amino Acids And Their Characteristics

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

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UNIT III Protein Architecture

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine

Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

UNIT IV Structure-Function Relationship

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V Protein Engineering

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, *de novo* protein design.

Text Books

1. Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", GarlandPublishing, NY, USA, 1999

References

1. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
2. Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1990.

BT215 ANIMAL BIOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT I Animal Cell Culture

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures-suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II Animal Diseases And Their Diagnosis

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, *in-situ* hybridization; northern and southern blotting; RFLP.

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UNIT III Therapy Of Animal Diseases
Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV Micromanipulation Of Embryos
What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V Transgenic Animals
Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

Text Books

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

Reference

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press, 2000

BT216 CANCER BIOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT I : Fundamentals Of Cancer Biology
Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II : Principles Of Carcinogenesis
Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III : Principles Of Molecular Cell Biology Of Cancer
Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

UNIT IV : Principles Of Cancer Metastasis
Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

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UNIT V :New Molecules For Cancer Therapy
Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

Text Books

1. Maly B.W.J, "Virology A Practical Approach", IRLl Press, Oxford, 1987.
2. Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.

Reference

1. "An Introduction Top Cellular And Molecular Biology of Cancer", j Oxford Medical Publications, 1991.

BT217 BIOPROCESS ECONOMICS AND PLANT DESIGN

Credit : 4:0:0 **Marks (40+60)**

UNIT I : Process Economics And Business Organizations
Definition of Process, Process Economics, Importance of various M-inputs-Globalization concept-Competition by Dumping-It's effect on Plant size-Status of India- Project profile concept-details; Structure and Types of Organizations

UNIT II : Project Design And Development
Choosing a Project, Market Survey, Importance of Techno-Economic-Feasibility Studies, Sourcing of Processes, Process alternatives, Fixing most economic processes, Technology-Scanning, Plant Location Principles, Plant Lay out, Process Flow sheets, Preparation of Budgetory investment and production costs.

UNIT III : Cost Estimation, Profitability And Accounting
Capital investment, Concept of time-Value of money, Source Sink concept of Profitability, Capital Costs, Depreciation, Estimation of Capital costs, Manufacturing Costs, Working Capital; Profitablity Standards, Project profitability evaluation, Alternative investments and Replacements; Annual reports, Balance Sheets, Performance Analysis.

UNIT IV : Process Optimization Techniques
Optimum design-Design Strategy, Economic-Balance, Design of Variables.

UNIT V : Quality And Quality Control
Current good manufacturing practices. Concepts of Quality Control in 20th century; Elements of quality control envisaged by BIS since 1947; Emergence of Statistical Process Control (SPC), Simple SPC concept details, Fundamental Concepts of ISO 9000 Quality System and the various requirements for ISO certification. Six sigma concept in Quality control

Text Books

1. Peters M.S., Klaus D. Plant Design and Economics for Chemical Engineers. McGraw-Hill International Edition, Chemical Engineering series, 1991.
2. Senapathy R. Text Book of Principles of Management and Industrial Psychology, Lakshmi Publications, 2001.

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Reference

1. Rudd and Watson. Strategy for Process Engineering, Wiley Publications.1987.

BT218 PROFESSIONAL ETHICS AND HUMAN VALUES

Credit : 4:0:0 **Marks (40+60)**

UNIT I : Human Values

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II : Engineering Ethics

Senses of "Engineering Ethics"' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III : Engineering as Social Experimentation

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT IV : Safety, Responsibilities and Rights

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies.

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V : Global Issues

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

Text Books

2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

References

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available)
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)

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3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

BT219 ENVIRONMENTAL BIOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

Unit I : Introduction

Origin and Definition of old and new biotechnology, Biotechnology a multidisciplinary growing tree, scope and importance of Biotechnology in India. Environmental Pollution - soil, water air, oil and heavy metal pollution, Types and causes and its effects on environment. Microbial flora of soils .

Unit II : Industrial waste water management

Aerobic and anaerobic waste water treatment, sewage disposal and treatment – physical and biological treatment, effluent treatment – primary and secondary treatment. Biological nitrogen and phosphate removal - waste water treatment in diary, distillery, tannery, sugar and industry pulp.

Unit III : Biomass

Types and composition of biomass, waste as renewable source of energy, methods of energy production, energy and fuel using microorganisms, conversion of methane to synthetic gas, cellulose as a source of energy, conservation of energy.

Unit IV : Bioremediation and biodegradation

Pseudomonas for bioremediation, types and reactions of bioremediation, biodegradation of hydrocarbons and pesticides, microbes in leaching of metals – leaching of copper and uranium, Control of air pollution, control devices for gaseous pollutants, volatile organic pollutants.

Unit V : Biodiversity

Biodiversity at global level, species diversity.Biodiversity and its conservation – *insitu* and *exsitu* conservation. Loss of biodiversity and its causes. Intellectual Property Rights (IPR) and patenting – patents for higher plants and animals

Text Books

1. Stanir R.Y. Ingraham J.L. Wheelis M.L. Painter R.R. General Microbiology, McMillan Publications, 1989.
2. Foster C.F. John ware D.A. Environmental Biotechnology, Ellis, Honwood Ltd. 1987.

Reference

1. Karnely D. Chakrabarty K. Ovnen G.S. Biotechnology and Biodegradation, Advances in Applied Biotechnology series, Vol. Gulf Publications Co. London 1989.

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BT220 ADVANCED BIOPROCESS LAB

Credit : 0:0:2 **Marks (50+50)**

12 experiments will be notified by the HOD from time to time

BT221 BASIC INDUSTRIAL BIOTECHNOLOGY

Credit : 4:0:0 **Marks (40+60)**

UNIT – I Introduction to Industrial Bioprocess

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

UNIT – II Production of Primary Metabolites

A brief outline of processes for the production of some commercially important Organic acids: citric acid, lactic acid, acetic acid; Amino acids: glutamic acid, lysine, phenyalanine, aspartic acid and Alcohols: ethanol, butanol.

UNIT – III Production of Secondary Metabolites

Study of production processes for various classes of secondary metabolites: Antibiotics-Beta-lactams: penicillin, cephalosporin, Aminoglycosides: streptomycin, Macrolides: erythromycin, Vitamins: Vit.B12, B2, Vit.A and Steroids.

UNIT – IV Production of Enzymes and Other Bioproducts

Production of Industrial Enzymes: proteases, amylases, lipases, cellulases and Enzyme Inhibitors: inhibitors of cholesterol synthesis. Production of Biopesticides, Biofertilisers, Biopreservatives: Nisin, Cheese, Biopolymers: xanthan gum, PHB and Single cell protein.

UNIT – V Production of Modern Biotechnology Products

Production of recombinant proteins having therapeutic and diagnostic applications: vaccines, monoclonal antibodies. Products of plant and animal cell cultures.

Text Book:

1. Casida Jr, L.E., (2000) Industrial Microbiology, New Age International (P) Ltd.
2. Wulf Cruger and Anneliese Crueger, (2003) Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation.

References

1. Presscott, Dunn, Industrial Microbiology, Agrobios (India).
2. Murrey Moo & Young, Comprehensive Biotechnology, Pergamon.
3. Ratledge & Kristiansen, Basic Biotechnology, IInd edition, 2004; Cambridge University press.

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BT301 ADVANCES IN GENETIC ENGINEERING

Credit: 4:0:0 **Marks: (40+60)**

UNIT- I Molecular Biology

Prokaryotic gene expression *invivo*, prokaryotic gene expression *invitro*. Eukaryotic gene expression in *E.coli* – fused genes, unfused genes, secreted proteins, expression in transgenic animals and plants,DNA engineering – oligonucleotide synthesis, linkers, adopters and connectors, mutagenesis, how to isolate a gene – plasmid and marker rescue techniques, Directed mutagenesis; transposon mutagenesis, Gene targeting, Site specific recombination, transposon tagging.

UNIT- II Gene Cloning

Gene library in a genomic library, cDNA library, phage lambda versus cosmids for gene libraries, mapping the DNA, restriction mapping – direct mapping, indirect mapping, DNA foot printing, chromosome walking, chromosome jumping.

UNIT- III Sequencing of Nucleic Acid

DNA sequencing – MAXAM and GILBERT chemical method, SANGER and COULSON enzymatic chain termination method – the primer, the template, the dideoxynucleotide termination and deoxynucleotides, the polymerase, Messing's shotgun method using computers for sequencing.

UNIT- IV Techniques in Genetic Engineering

Introduction to DNA finger printing, basic genetic principle, Variable Number of Tandem Repeats (VNTRs)/ Minisatellite sequences, Short Tandem Repeats (STRs)/ Microsatellite sequences, Hybridization based DNA fingerprinting (RFLP) PCR-based DNA fingerprinting, Single locus and multi-locus DNA fingerprinting , Applications of DNA fingerprinting - Criminal investigation, personal identification, Immigration, Paternity dispute etc.

UNIT- V Applications and Hazards of Genetic Engineering

Exploitation of genetic engineering, gene banks, Applications of genetic engineering,Genetic Engineering – Hazards and Impact on society.

Text Books:

1. Genes VI and Genes VII by Benjamin Lewin, Oxford University Press, Cambridge, U.K, 7th ed, 2000.
2. Principles of cloning by Jose Cibelli,Robert P.Lanza, Keith H.S. Campbell, Michael D.West, Academic Press, 2002.

Reference Books

1. "From Genes to Clones" by Ernat-.L.Winnacker, Panima Publishing Corporation, India, 2003.
2. "Biotechnology : Fundamentals and Applications" by S.S. Purohit , Agrobios(Ind), Jodhpur, 2002.
3. "Principles of Biochemistry" by H.Robert Horton, Lawrence .A. Moran ,Raymond .S.Ochs, J.David Rawn & K. Gray Scrimgeour, Prentice Hall, 3rd ed,2002.
4. "Gene Cloning – An Introduction" by T.A.Brown,VNR (U.K) Co.Ltd, England,1988.

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BT302 GENETIC ENGINEERING LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

BT303 ADVANCED BIOPROCESS ENGINEERING

Credit: 4:0:0 **Marks: (40+60)**

Unit- I Data Analysis in bioprocess

Collection and analysis of data on bioprocess engineering, mass and energy balances for steady state and unsteady state biochemical systems; Fluid flow and mixing; sterilization of air and media; mass transfer in biological systems.

Unit- II Overview of Fermentation Processes and Scale-up Criteria

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Scale-up criteria for mixing- power requirements for agitation; mass transfer correlations- dynamics of multiple interacting microbial species, Prey- Predator interaction oscillations.

Unit- III Reaction Kinetics in bioprocess

Reaction kinetics for biological systems- M.M kinetics, enzyme deactivation kinetics; heterogenous reactions in bioprocessing- concentration gradients and reaction rates in solid catalysts, internal mass transfer in heterogenous reactions; Thiele modules - solid – liquid mass transfer correlations, minimizing mass transfer effects.

Unit- IV Bacterial growth kinetics

Simple unstructured and structured kinetic models for growth of bacterial and filamentous organisms; growth associated product formation kinetics- determination of oxygen transfer coefficients, formulation of models for various biochemical processing systems in steady and unsteady state conditions; Design and analysis of packed bed & membrane bioreactors.

Unit- V Process Control

Online data analysis of physico chemical parameter measurements for biochemical processes; Concepts of process control- Application of Artificial Intelligence, Fuzzy logic and neural networks in bioprocess control, Case studies on bioreactor control problems.

Textbooks:

1. Bioprocess Engineering, by Bjorn K. Lydersen (Editor), Nancy A. D'Elia (Editor), Kim L. Nelson (Editor), Wiley-Interscience; 1st edition, 1994
2. Biochemical Engineering Fundamentals – 2nd edition Bailey and Ollis, Mcgraw Hill 1986

Reference Books

1. Bioprocess Engineering Principles – Pauline M Doran, Academic Press, 1995.
2. Biochemical Engineering by James M.Lee , Prentice Hall 1992

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3. Bioreactors in Biotechnology – A practical approach by A.H.Scragg; 1991.
4. Bioreactor Design and Product Yield , Biotol Series, Butterworth – Heinemann; 1993.

BT304 BIOPROCESS ENGINEERING & DOWNSTREAM PROCESSING LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

BT305 METABOLIC REGULATIONS AND ENGINEERING

Credit: 4:0:0 **Marks: (40+60)**

UNIT - I Overview of Primary and Secondary Metabolic Pathways
A brief outline of processes for the production of some commercially important primary metabolites such as amino acids and alcohols, various classes of secondary metabolites such as secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids, Industrial enzymes such as proteases, amylases, lipases, cellulases etc.,and enzyme inhibitors such as inhibitors of cholesterol synthesis.

UNIT – II Metabolic Regulations
Operon concept-Regulation of gene expression in prokaryotes-Lac operon. Regulation of gene expression in eukaryotes- catabolite regulation. Regulation of RNA synthesis by amino acid. Feed back regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation. Permeability control: passive diffusion, active transport, group transportation.

UNIT –III Metabolic Engineering of Primary Metabolites and enzymes
Primary metabolites: Alteration of feed back regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites. Enzymes: Strain selection, improving fermentation, recognising growth cycle peak, induction, feed-back repression, catabolite repression, mutants resistant to repression, gene dosage.

UNIT – IV Metabolic Engineering of Secondary Metabolites
Producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

UNIT - V Metabolic Engineering in Bioconversions
Metabolic bioconversion pathways, Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

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Text books

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., " Fermentation And Enzyme Technology ", John Wiley And Sons., 1980.
2. Zubay G., " Biochemistry ", Macmillan Publishers, 1989.

BT306 ADVANCED IMMUNOTECHNOLOGY

Credit: 4:0:0 **Marks: (40+60)**

UNIT I Antigens

Types of antigen, their structure, preparation of antigen for raising antibodies, peptide antigens preparation, handling of animals, adjuvants and their mode of action, identification of antigens by molecular techniques

UNIT II Antibodies and Immunodiagnosis

Recombinant monoclonal and polyclonal antibodies – their production and characterization, Western Blot analysis, Immunoeletrophoresis, SDS-PAGE, Purification and synthesis of antigens; ELISA – Principle and application; Radio Immuno Assay (RIA) – Principles and applications; non isotopic methods of detection of antigens – enhanced chemiluminescence assay.

UNIT III Techniques to assay Cell Mediated Immunity

Identification of lymphocytes and their subsets in blood, T-cell activation parameters, estimation of cytokines, macrophages activation, macrophage microbicidal assays, invitro experimentation; application of the above technology to understand the pathogenesis of infectious diseases and treatment; cytotoxicity assay; helper T- cell assay; cytotoxic T- cell assay.

UNIT IV Immunopathology

Preparation of storage of tissues, identification of various cell types and antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immunocytochemistry – immunofluorescence, immunoenzymatic and immunoferrtine techniques, immuno electron microscopy, ELISA and ELISPOT

UNIIT V Molecular Immunology

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system production anti idiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies, immunotherapy with genetically engineered antibodies.

Text Books:

1. Talwar G. P., and Gupta S.K., A Hand book of Practical and Clinical Immunology, Vol. 1 & 2, CBS Publications, 2004.
2. Weir D.M., Practical Immunology, Blackwell Publications, 1990.

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References:

1. Austin J.M. and Wood K.J., Principles of Cellular and Molecular Immunology, Oxford University Press, Oxford, 1993.
2. Frank C. Hay, Olwyn M. R. Westwood, Paul N. Nelson, Hudson Practical Immunology , Blackwell Publishers; 1st edition, 2002.

BT307 IMMUNOTECHNOLOGY LAB

Credit: 0:0:2 **Marks: (50+50)**

12 experiments will be notified by the HOD from time to time

BT308 PLANT AND ANIMAL BIOTECHNOLOGY

Credit: 4:0:0 **Marks: (40+60)**

UNIT –I Introduction

Biotechnology: Scope of Biotechnology, Role of Biotechnology in third world countries, Biotechnology –basic needs of human beings(food, shelter & medicine)

UNIT – II Plant Genetic Engineering

Genetic Engineering – Techniques for the insertion of foreign genes into plant cells. Ti plasmid and vectors, production of Transgenic plants, gene cloning and restriction fragment length polymorphisms, transposons, and insertional mutagenesis. Molecular biology of nitrogen fixation, nif-gene transfer, herbicide resistance and stress tolerance in plants, Bioinsecticdes and Biofertilizers

UNIT – III Plant Tissue Culture in Biotechnology

Tissue culture as a source of genetic variability: somaclonal and gametoclonal variant selection sources and causes of variation, application in crop improvement, protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, somatic hybridization and Cybridizatoin – plant cell cultures for the production of useful chemicals : pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds.

UNIT – IV Animal Cell Culture and Gene Cloning in Biotechnology

Basic techniques of animal cell culture and their applications, gene cloning techniques for mammalian cells, transgenic animals, In vitro fertilization and embryo transfer, AIDS, cancer – oncogenes, proto – oncogenes and tumor suppressor genes. Vaccines and hormone signal transduction

UNIT – V Animal Genetic Engineering and Ethical Issues

Techniques for gene transfer in animals, xenotransplantation, patenting genetically engineered animals, mapping of human Genome, ethical issues in Animal Bio technology, intellectual property Rights (IPR) and patenting

Text Books

1. Bojwani, S.S. 1990. Plant Tissue Culture : Applications and Limitations.

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2. Elsevier,Amsterdam
3. Doyle, A.R. Hay and B.E. Kirsop 1990 Living Resources for bio technology
4. Cambridge University press,Cambridge

Reference

1. Grierson,D. and S.N. convey : plant Biotechnology in Agriculture

BT309 ENVIRONMENTAL BIOTECHNOLOGY

Credit: 4:0:0 **Marks: (40+60)**

Unit I : Introduction

Origin and Definition of old and new biotechnology, Biotechnology a multidisciplinary growing tree, scope and importance; of Biotechnology in India. Environmental Pollution - soil, water, air, oil and heavy metal pollution, Types and causes and its effects on environment. Microbial flora of soils .

Unit II : Industrial waste water management

Aerobic and anaerobic waste water treatments, Purification of waste bleach water. Laboratory methods for the reduction of coli form organisms in water. Water recycling methods, management of radio active pollutants in water, Management of sludge and solid waste treatment – land filling, lagooning, Mechanism of composting.

Unit III : Biomass

Biomass waste as renewable source of energy, methods of energy production, energy and fuel using microorganisms, conversion of methane to synthetic gas, bioremediation of contaminated land – *insitu* and *exsitu* bioremediation, cellulose as a source of energy, conservation of energy.

Unit IV : Bioremediation and biodegradation

Types and reactions of bioremediation, biodegradation of hydrocarbons, pesticides, herbicides, insecticides and xenobiotics. Genetically engineered microbes for bioremediation, bioremediation of ground water, microbial recovery of petroleum, control of oil pollution. Control of air pollution, control devices for gaseous pollutants, volatile organic pollutants, biological oxygen demand, BOD sensors. Green house gases and its control.

Unit V : Biodiversity

Biodiversity at global level, species diversity.Biodiversity and its conservation – *insitu* and *exsitu* conservation. Loss of biodiversity and its causes. Intellectual Property Rights (IPR) and patenting – patents for higher plants, animals genes and DNA sequences. Plant breeders rights and farmers rights.

Text Books

1. Foster C.F. John Ware D.A. Environmental Biotechnology, Ellis Horwood Ltd. 1987.
2. Chakrabarty K.D. Omen G.S. Biotechnology and Bio degradation, Advances in Applied Biotechnology series, Vol. 1, Gulf Publications Co. London 1989.

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References

1. Stanier R.Y. Ingraham J.L. Wheels M.L. Painter R.R. General Microbiology, McMillan Publications, 1989.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., Mc Graw Hill, 1986.
3. Alam Scragg, Environmental Biotechnology, Publication & Distributors Harlow, Engg. Longman, 1999.

BT310 PROFESSIONAL ETHICS AND BIOETHICS

Credit: 4:0:0 **Marks: (40+60)**

UNIT I Engineering Ethics

Senses of "Engineering Ethics"' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT I Intellectual Property Rights And Patenting

Intellectual Property Rights (IPR) - discrimination, International conventions patents and methods application of patents. Legal implications, Biodiversity and farmers rights

UNIT III Bioethics And Biosafety

Bioethics, Bioterrorism, Biosafety issues - pesticide residues. GMOs – Transgenic plants and Animals

UNIT IV Safety, Responsibilities And Rights

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and Chernobyl case studies.

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights

UNIT V Global Issues

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

Text Books

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

References

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available)

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2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Sasson A. "Biotechnologies and Development", UNESCO Publications 1988.
6. Singh K. "Intellectual Property Rights on Biotechnology", BCIL, New Delhi.

BT311 ADVANCED BIOPHARMACEUTIUCAL TECHNOLOGY

Credit: 4:0:0 **Marks: (40+60)**

UNIT- I: Introduction
Development of Biopharmaceutical Industry, Therapeutic agents, uses and Economics.

UNIT- II: Biologic drug Metabolism and Pharmacokinetics
Biologic Drug metabolism – Physico Chemical principles – Pharma Kinetics – Action of drugs on human bodies.

UNIT- III: Unit Operations in Biopharmaceutical Technology
Production of water for biopharmaceutical use, Filtration, mixing, Drying.
Freeze drying, Sterilisation

UNIT- IV: Biopharmaceuticals
Various categories of plant, animal and microbial derived therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

UNIT- V: Quality Control and Quality Assurance of Dosage Forms
Analytical methods and tests for various drugs and Pharmaceuticals. Packing – Packing Techniques – Quality control , Good manufacturing practice.

Text Books
1. Biotechnology and Biopharmaceutical Manufacturing, Processing, and Preservation (Drug Manufacturing Technology Series, Vol 2), by Kenneth E. Avis (Editor), Vincent L. Wu, CRC Press, 1996.
2. Remington's Pharmaceutical Sciences, Mack Publishing and Co, 1990.

Reference:
1. A.C.Guyton. Text book of medical physiology, W.B.Saunders, Hong Kong 1986.

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BT312 ENZYME TECHNOLOGY AND INDUSTRIAL APPLICATIONS

Credit: 4:0:0 **Marks: (40+60)**

Unit –I Kinetics and mechanism of enzyme action

Classification of enzymes; quantification of enzyme activity and specific activity. Estimation of Michaelis Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple substrate reactions.

Unit –II Immobilised enzyme reactions

Techniques of enzyme immobilisation-matrix entrapment, ionic and cross linking, column packing; Analysis of mass transfer effects of kinetics of immobilised enzyme reactions; Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized enzyme reactions; calculation of Effectiveness Factors of immobilized enzyme systems; Bioconversion studies with immobilized enzyme packed -bed reactors.

Unit –III Mass transfer effects in immobilised enzyme systems

Analysis of film and Pore diffusion Effects on kinetics of immobilised enzyme reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors

Unit –IV Application of Enzymes

Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Use of enzymes in analysis-types of sensing-gadgetry and methods. Case studies on application - chiral conversion, esterification etc.,

Unit –V Enzyme biosensors

Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

Text Books:

1. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
2. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

References:

1. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
2. Lee, James M. Biochemical Engineering, PHI, USA.

BT313 RESEARCH METHODOLOGY

Credit: 4:0:0 **Marks: (40+60)**

UNIT- I: Introduction to research

The hallmarks of scientific research – the building blocks of science in research – relevance to preliminary information, the research process for applied and basic research. Hypothesis development. Laboratory safety, bio safety, recombinant material safety.

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UNIT- II: Experimental designs

The laboratory and the field experiment – internal and external validity – factors affecting internal validity. Measurement of variables – scales and measurements of variables. Developing scales: rating scale and attitudinal scales. Validity testing of scales developed. Reliability concept in the scales being developed. Stability measures. In vitro, in vivo and clinical trial designs, rules and regulation for animal and human experiments.

UNIT- III: Data collection methods

Interviewing questionnaires etc. secondary sources of data collection. Guidelines for questionnaire design – electronic questionnaire design and surveys. Special date sources: focus groups, static and dynamic panels. Review of the advantages and disadvantages of various data collection methods and when to use each. Sampling techniques. Probabilistic and non – probabilistic samples. Issues of precision and confidence in determining sample size. Hypothesis testing. Determination of optimal sample size. Data relevance to intellectual property rights (IPR), bookkeeping.

UNIT- IV: Biostatistics

Definition and scope, Types of biological data – Collection and presentation of data (Table, Graphs, Diagrams). Measures of central tendency, Dispersion : Skewness and Kurtosis; Probability analysis – Testing of significance – Goodness of fit (X2 test) – Student's – test – Simple & multiple regression – Correlation: Canonical Correlation – Correlation coefficient– ANOVA (one way and two way analysis). Factor analysis – Cluster analysis – Discrimnant analysis. Application of SPSS package.

UNIT- V: The Research Report

The purpose of the written report – concept of audience – Basics of written reports. The integral parts of a report – the little of a report, the table of contents, the synopsis, the introductory section, method section, results section – discussion section – recommendations and implementation section and reference section.

Text Books:

1. Donald R. Cooper and remela S. Schindler, Business Research Methods, Tata McGraw Hill publishing company limited, New Delhi, 2000.
2. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.
3. C.R. Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2001.

References:

1. Donald H. McBurney, research methods, Thomson Asia Pvt. Ltd. Singapore, 2002
2. G.W. Ticehurst and A.J. Veal, Business research methods, Longman, 1999.
3. Ranjit Kumar, Research methodology, Sage Publications, London, New Delhi, 1999.
4. Raymond – Alain Thie' tart, et. Al., Doing Management research, Sage publications, London, 1999.

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BT314 INSTRUMENTATION AND BIOTECHNIQUES

Credit: 4:0:0 **Marks: (40+60)**

Unit-I Introduction to Methodology

Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Citation literature. Internet resources, basic concepts in computer operations. Significance of research, research methods versus methodology, research and scientific methods. Defining the research problem, research design.

Unit-II Separation and Analysis

Principles of Chromatography: lon exchange, size exclusion, and Affinity column, HPLC and Gas chromatography, GLC: GCMS. Centrifugation high speed and ultra, Electrophoresis – Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis, Isoelectrofoccusing:

Unit-III Structural Elucidation and Analysis

Principles and applications of the following: Microscope – Flourescence, Confocal, Phase contrast, Electron (Scanning and Transmission) –Radio isotopic techniques-X ray diffraction, RIA, scintillation counter, GM counter, Autoradiography. NMR, CD, IR, DSC. Spectrophotometry – Principle and application of Spectrophotometer – Visible, UV, Atomic absorbtion spectrophotometer – Spectrofluorimetry, Flowcytometry, Immunotechniques – ELISA, Immunoblotting, Characterization of chromosomes by various banding techniques.

Unit-IV Cell Culture and Molecular Biological Techniques

Preparation of Culture media, Modes of sterilization, Culture of microbes, Plant and animal cell and Tissue, Bioprocess Engineering: Operation types: Continuous, Batch, Fed batch. Designs: Fluidized bed, Packed bed, Immobilization of enzyme and cells. Nucleic acid isolation – Isolation of genomic DNA, RNA, Plasmid DNA, PCR and; Blotting techniques and Hybridization techniques.

Unit-V Bioinformatics

Biological data base-nucleotide, protein-structural and sequencial data base. Gene and protein expression data. Sequence analysis-BLAST, FASTA: Sequence comparision, alignment, building phylogenetic trees. Use of microarrays to study gene expression and protein expression. Molecular visualization tools study protein structure, bioinformatics and drug discovery.

Text Books:

1. Jerrold H.Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
2. Attwood. T.K and Parry-Smith D.J.(2002). Introduction to Bioinformatics, Pearson education. Singapore.
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

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References:

1. C.R.Kothari, IInd edition (2004). Research Methodology, Methods and techniques. New age International(P)Ltd,Publishers, New Delhi.
2. M.K Razdan (2003). Plant Tissue Culture, Oxford and IBH Publishing Co.Pvt.Ltd., New Delhi.

BT315 PLANT AND ANIMAL BIOTECHNOLOGY FOR FOOD ENGINEERS

Credit :3:1:0 **Marks: 40+60**

Unit I: Introduction

Plant and Animal Biotechnology - product safety, public perception of Biotechnology – Legislation, Regulatory and safety aspects of GMOs, GMFs. Transgenics – Ethical concerns and solutions - Importance in Bio protection and conservation

Unit II:

Plant cell and tissue culture - Techniques involved - Protoplast isolation, culture and fusion, Properties and applications of Hairy root cultures – Bioreactors for Plant cell and Tissue cultures - Plant cell cultures for the production of food-related chemicals: pigments perfumes, flavors

Unit III:

Genetic Engineering - Techniques for the insertion of foreign genes into plant cells, Ti plasmid and vectors, production of transgenic plants, (i) Transgenic plants (ii) gene cloning, restriction fragment length polymorphisms, transposons, and insertional mutagenesis – Transgenic plants as sources of modified oils

Unit IV:

Basic techniques of animal cell culture and their application – Introduction of novel genes – Transfection, Retrovirus vectors, nuclear transfer for mammalian cells, transgenic animals, in vitro fertilization and embryo transfer, molecular biological techniques for rapid diagnosis of genetic diseases

Unit V:

Applications of animal biotechnology - Production of biopharmaceuticals, xenotransplantation, Gene therapy – Basics and application to cancers and Tumours – Therapeutic applications of antisense nucleic acids

Text Books:

1. Genome Organization and Expression in Plants: C.J. Lever, plenum press Plant Molecular biology: D. Grierson & S.N. Covey Blackie, London.
2. Plant Tissue Culture: Applications and Limitations. S.S. Bhojwani (1990), Elsevier, Amsterdam.
3. Plant biotechnology In Agriculture: K. Lindsey and M.G.K. Jones (1990), Prentice hall, New Jersey.
4. R.E. Spier and J.B Griffiths. Animal cell Biotechnology, Academic Press. (1998)

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5. Johnson A. and Holland A Animal Biotechnology and Ethics , Chapman and Hall, Madras, 1998.
6. Hui, K.M. Gene therapy – From Laboratory to the Clinic, World Scientific Publishing Co. Pvt. Ltd. Singapore, 1994.
7. Dashek W.V. Methods in Plant Biochemistry and Molecular Biology, CRC Press, 1997.
8. Kirsi-Marja Oksman-Caldentey and Barz W.H. Plant Biotechnology and Transgenic Plants, Marcel Dekker Inc., 2002.
9. Living resources for Biotechnology, Animal cells ; a.Doyle, R.Hay and B.E. Kirsop (1990), Cambridge University Press, Cambridge.

BT316 METABOLIC ENGINEERING

Credit : 3:1:0 **Marks: 40+60**

Unit I: Introduction

Jacob Monod model for gene expression regulation-Lac operon, catabolite regulation-glucose effect- cAMP deficiency. Regulation of RNA synthesis by amino acid. Feed back regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, permeability control: passive diffusion, active transport, group transportation.

Unit II: Synthesis Of Primary Metabolites

Alteration of feed back regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites.

Unit III: Biosynthesis Of Secondary Metabolites

producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

Unit IV: Bioconversions

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

Unit V: Regulation Of Enzyme Production

Strain selection, improving fermentation, recognising growth cycle peak, induction, feed-back repression, catabolite repression, mutants resistant to repression, gene dosage.

Text books

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., " Fermentation And Enzyme Technology ", John Wiley And Sons., 1980.
2. Zubay G., " Biochemistry ", Macmillan Publishers, 1989.

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BT317 DOWN STREAM PROCESSING

Credit : 3:1:0 **Marks (40+60)**

Unit I:
Introduction to bioseparation - Characterisation of biomolecules and fermentation broths; roles of downstream processing in biotechnology; broad strategies for design of bioseparation processes.

Unit II:
Cell disruption, solid – liquid and size – based separations - Cell disruption-mechanical and chemical methods; cake filtration and microfiltration; centrifugation and sedimentation. Membrane processes – dialysis, ultrafiltration, reverse osmosis and electrodialysis.

Unit III:
Isolation of products - Solvent extraction of small molecules; aqueous two – phase extraction of proteins; precipitation of proteins with salts and with organic solvents; adsorption processes.

Unit IV:
Product purification - Chromatography – principles of chromatographic separations – gel filtration, reversed phase, hydrophobic interaction, ion-exchange, IMAC and bio-affinity chromatography, design and selection of chromatographic matrices; modes of operation; design of large scale chromatographic separation processes; electrophoretic separation processes; alternative procedures - moving bed, expanded bed.

Unit V:
Final product purification and preparation - Crystallisation, drying and lyophilisation; formulation strategies; product characterisation and conditioning - criteria and methods for quality control of therapeutic proteins and recombinant proteins, conditioning.

Text Books:

1. Paul.A. Belter, E.L. Cussler and Wei shan Hu, Bioseparation – Downstream processing for Biotechnology- Wiley Inter Science Pub. (1988)
2. Product recovery in Bioprocess Technology Biotechnol Series. Biotechnical series, Butterworth Heinmann (1992)
3. J Asenjo (ed) separation Processes in biotechnology, Marcel-Dekker (1993)
4. Verrall, M.S. and Hudson M J Separations for Biotechnology, Ellis Horwood Ltd., (1990)
5. Robert K. Scopes Protein purification : Principles and practive, 3rd Edn, Springer Verlag, (1994)
6. M.A. Vijayalakshmi, Biochromatography : Theory & Practice, Taylor and Francis (2002)

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ADDITIONAL SUBJECTS

Code	Subject	Credit
FP217	Radiation Preservation and Processing	4:0:0
FP218	Processing of Foods Lab - 2	0:0:2
FP219	Food Engineering and Packaging Lab	0:0:2
FP220	Analysis of Food Commodities Lab – 2	0:0:2
FP221	Protein Chemistry And Engineering For Food engineers	3:1:0
FP222	Food Refrigeration Engineering and Technology	4:0:0
FP223	Principles of Food Processing	4:0:0
FP301	Principles of Instrumental Analysis for Food Engineers	3:1:0
FP302	Food chemistry	3:1:0
FP303	Food Technology – I	3:1:0
FP304	Food additives	3:1:0
FP305	Food Engineering – I	3:1:0
FP306	Food Engineering – II	3:1:0
FP307	Food Technology – II	3:1:0
FP308	Non-thermal methods of Food preservation	3:1:0
FP309	Food Packaging Technology	3:1:0
FP310	Analysis of Food Constituents Lab	0:0:2
FP311	Enzymology lab	0:0:2
FP312	Food and Chemical Engineering Lab	0:0:2
FP313	Food Processing and Packaging Lab	0:0:2
FP314	Protein Chemistry and Engineering for Food Engineers	3:1:0
FP315	Design and Analysis of Heat Transfer Equipments	3:1:0
FP316	Spray Drying: Application in the Food Industries	3:1:0
FP317	Analysis of Food Commodities Lab	0:0:2

FP217 RADIATION PRESERVATION AND PROCESSING

Credit: 4:0:0 **Marks 40+60**

Unit I Basics of Radiation Chemistry

Ionizing Radiations; Concept of radiation, definitions, ionization and excitation, radiations for treating foods, interaction of ionizing radiation with food matter, quantitative relationships - Radiation chemistry basics, primary chemical effects and secondary effects on good. G value, role of irradiation parameters, dosage dose rate, water content, temperature, additives, post irradiation effects, times for various radiation events.

Unit II Radiation Chemistry Of Food Components

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

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Unit III Microwaves In Food Processing

Electronic heating terminology, microwave energy, nature of energy, batch and continuous ovens, conveyorized ovens, microwave generators, wave guides, brief description of oven construction, Industrial application of microwave radiation, dielectric properties and radiation, Applications in dehydration, baking, blanching, thawing, pasteurization/ sterilization and processing of meat products.

Unit IV Infra red Radiation

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation- Propagation of IR radiation in food stuffs. IR generators, Radiation equipment, Instruments for measuring radiation - some applications in food technology - Relative merits and demerits of IR radiation over other radiations

Unit V Radio Frequency Heating Principles

Advantages of Radio frequency heating of foods- RF heating equipment including conveyorized dryers - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment

Text Books

1. J.F.Diehl: *Safety of Radiated Foods* Marcel Dekker Inc. NY (1995)
2. Robert V. Decareau: *Microwaves in Food Processing Industry* Academic Press inc. New York (1985)
3. Gould G.W. *New Methods of Food Preservation*, Aspen Publisheres Inc. Maryland. 1999.

Reference Books

1. Welter M. Urbain: *Food Irradiation* Academic Press, New York (1986)
2. Wilkinson Guild: *Food Irradiation – A Reference Guide* Woodhead Publishing, Cambridge, UK (1996)
3. Ohlsson and Bengtson: *Microwave Processing Technologies* Woodhead Publishing, Cambridge, UK (2002)
4. S.G.Llyasor and V.V. Krasnikov: *Physical Principles of Infra Red Irradiation of Food Stuffs:* Hemisphere Publishing Corporation, London (1991)
5. Philip Richardson: *Thermal Technologies for Food Processing* Woodhead Publishing Limited, CRC Press. (2001)
6. Robert V. Decareau: *Microwave Foods, New Product Development* Food & Nutrition Press Inc. USA (1992)
7. A.S. Ginzburg: Applications of Infra-Red Radiation in Food Processing Leonord Hill, London (1969)

FP218 PROCESSING OF FOODS LAB - 2

Credit: 0:0:2 **Marks 50+50**

12 experiments will be notified by the HOD from time to time

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FP219 FOOD ENGINEERING AND PACKAGING LAB

Credit: 0:0:2 **Marks 50+50**

12 experiments will be notified by the HOD from time to time

FP220 ANALYSIS OF FOOD COMMODITIES LAB - 2

Credit: 0:0:2 **Marks 50+50**

12 experiments will be notified by the HOD from time to time

FP221 PROTEIN CHEMISTRY AND ENGINEERING FOR FOOD ENGINEERS

Credit : 3:1:0 **Marks (40+60)**

UNIT I Basics of amino acids and protein chemistry

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II Protein Architecture

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine

Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

UNIT III Protein Engineering

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, *de novo* protein design.

UNIT IV Properties of Food proteins – Animal and Marine sources

Caseins and Whey proteins

Caseins – Heterogeneity and Molecular properties – caseins micelles – Mechanism of stabilization – Structure models – Structure of whey proteins and improvement of functionality

Muscle proteins – Structure and functionality – Application of muscle proteins in foods

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Sea weed proteins – Protein content and functionality, digestibility of algal proteins – applications to food systems

UNIT V Properties of Food proteins – Plant sources

Compostion, Properties and functional properties of soya, rapeseed**,** peanut.
Leaf as a protein soure – Basic and Food applications of rubisco

Text Books

1. Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999
3. P. F. Fox, J. J. Condon. Food Proteins, Kluwer Science, 1982.
4. B. J. F. Hudson. *New and Developing Sources of Food Proteins*, Chapman and Hall, 1994.
5. Zidzisław E. Sikorski, *Chemical and Functional Properties of Food Proteins*, CRC Press, 2001.

Reference Books

1. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
2. Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1999

FP222 FOOD REFRIGERATION ENGINEERING AND TECHNOLOGY

Credit : 4:0:0 **Marks 40+60**

Unit I Principles of Refrigeration

Refrigeration cycles, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Ozone Depletion Potentials, Green house Potential Refrigerants, use of non polluting refrigerants, net refrigerating effect, ton of refrigeration - Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls. Atmospheric air and its properties, Psychometrics, Energy considerations

Unit II Cold Storage Design and Construction

Small and large commercial storages, Cold Room temperatures, Insulation, properties of insulating materials, air diffusion equipment, Doors and other openings. Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures, insulation of freezer rooms: Pre-cooling and pre freezing. Cold Storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials-meat and poultry products, marine products, fruits and vegetables, spices and food grains

Unit III Effect of cold storing on quality of certain food products

Operation and maintenance, Cleanliness, defrosting practices, preventive maintenance, safety measures

Controlled atmosphere and Modified atmosphere storages

Principles and basics of their construction

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Unit IV Chilling of Foods

Chilling equipment for liquid foods. Secondary refrigerants and direct expansion techniques in chilling. Chilled foods transport and display cabinets - Basics of Chilled foods microbiology, Packaging of Chilled foods - Hygienic design considerations for chillers and chilled Storages. Cool Storages and their applications. Evaporative cooling and its applications

Unit V Freezing of foods

Freezing equipment, Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Blast freezers, Contact Plate Freezers, conveyorized quick freezers, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables.

Text/Reference Books

1. Raymond R.Gunther: *Refrigeration, Air conditioning and Cold Storage* Chilten Company, Philadelphia, USA 1957
2. Clive D.J.Dellino: *Cold and Chilled Storage Technology* Publisher: Kluwer Academic Publishers (1997)
3. S. Domkundwar and Subhash Arora: *A Course in refrigeration and Air Conditioning:* Dhanpat Rai and sons, Publishers, New Delhi (1994)
4. Andrew D Althouse and others: *Refrigeration and air Conditioning* Goodheart – Willcox Company Inc. 1982
5. E.R.Hollowell: *Cold Storage and Freezer Storage Manual* AVI Publishing Co. (1980)
6. Ed. C.P.Mallet: *Frozen Food Technology* Balckie Academic and Professional, (1993)
7. Aurel Gobaneu and Gabriala Laseha and others (1976) *Cooling Technology in the Food Industry:* Abacus Press, Tunbridge Wells, U.K.
8. Colin Dennis and Michael Stringer: *Chilled Foods – A Comprehensive Guide* Ellis Horwood Publishing, New york (1992)
9. D.K.Tressler and C.F.Evers: *The Freezing Preservation of Foods (Vol.1&2)* AVI Publishing Company Inc. USA (1965)
10. J.S.Pruthi: *Quick Freezing Preservation of Foods (2 Volumes)* Allied Publishers, Mumbai (1999)

FP223 PRINCIPLES OF FOOD PROCESSING

Credit : 4:0:0 **Marks (40+60)**

UNIT I : Fundamentals of Food Chemistry

Carbohydrates – Classification – Simple & complex, mono-, di-, oligo- and polysaccharides; Important reaction of carbohydrates –Caramelisation, Maillard

Fats – classification – Analysis of Fats and oils – Saponifcation value, Iodine value, Acid value, Acetyl value, Peroxide value – Principles and Importance of the analytical methods

Vitamins – Fat and water-soluble – nutritional significance

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UNIT II : Food Additives
Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III : Microorganisms Associated With Food
Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV : Food Borne Diseases
Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V : Food Preservation
Principles involved in the use of sterilization, pasteurization and blanching, methods of determination of thermal death time (Graphical, mathematical) – D, Z and F values – Importance of 12 D concept, Time – Temperature indicators - Canning; frozen storage-freezing methods, factors affecting quality of frozen foods; irradiation preservation of foods.

Text Books

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.

References

1. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., McGraw-Hill Book Co., New York 1988.
2. J.M. Jay – Modern Food Microbiology, CBS Pub. New Delhi, 1987.

FP301 PRINCIPLES OF INSTRUMENTAL ANALYSIS FOR FOOD ENGINEERS

Credit : 3:1:0 **Marks: 40 + 60**

Unit I:
Nucleotide, DNA and Protein Analysis- DNA purification, PCR-based analysis; DNA finger printing; DNA sequencing.
Immuno-techniques - Antiserum production, Immunofluroscence, immunohistocompatibility ELISA; localization of cells in tissues immunoblotting; monoclonal antibodies.

Unit II:
Chromatography - Classification- Classical chromatography- HPLC, adsorption, ion exchange chromatography- Gas chromatography; Immobilized metal affinity chromatography – Ion chromatography, Supercritical Fluid chromatography

Karunya University

Unit III:
Spectroscopy – NMR – Liquid and solid, IR, FTIR, Fluorimetry

Unit IV:
Colorimetry and Spectrometry - Radio active techniques, Spectrophotometer, Atomic absorption spectroscopy

Unit V:
Non-destructive methods of analysis of Food Commodities

Text books:

1. D. Holme. H. Peck, Analytical Biochemistry, Longman Publications, 3rd Edition.
2. Willard and Merrit Instrumental Methods and Analysis. VI Edition CBS Publishers & Distributors.
3. Ewing GW, Instrumental Methods of Chemical Analysis, Mc Graw Hill Book Company, 1989.

Reference Books:

1. Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987.
2. Rouessac F. and Rouessac A. Chemical Analysis: Modern Instrumentation Methods and Techniques, John Wiley and Sons. Ltd. England, 2000.

FP302 FOOD CHEMISTRY

Credit : 3:1:0 **Marks : 40 + 60**

Unit I:
Water and ice: Importance of water in foods. Structure of water & ice. Concept of bound & free water & their implications - Dispersed systems – some basic considerations - Structure activity relationship related to taste
Chemistry of Carbohydrates: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars - Chemistry, properties and preparation of Pectic substances, gums & polysaccharides, Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins

Unit II: Chemistry of lipids
Definition & classification of lipids. Basic Structures, Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospolipids, and unsaponifiables, Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, shortening agents, confectionary fats, cocoa butter substitutes and equivalents. Rancidity of fats & oils, and its prevention, antioxidants- Process flow sheet for the manufacture of edible oils (refined and hydrogenated)

Unit III: Chemistry of Proteins:
Importance of Proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides & Proteins. Sources and distribution of Proteins. Isolation, identification & purity of Proteins. Denaturation. Physical & chemical characteristics of Proteins. Protein based emulsions and foams.

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Unit IV:
Enzymes: Introduction, Nature, Function, classification & nomenclature of enzymes. Specificity. Amylases, Pectic Enzymes, Proteases; Oxidoreductases- Phenolases, Glucose Oxidases, Catalases, Peroxidases, Lipoxygenases, Xanthine Oxidases, Immobilized enzyme- One example of working of each enzyme. Assay Techniques. Isolation & purification of enzymes & their importance

Unit V: Chemistry of Vitamins:
Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins – Reasons for the loss of vitamins in foods – Fat-soluble and water soluble vitamins – Choline, carnitine

Text Books:

1. Owen R Fennema : Food Chemistry – III edition Marcel Dekkar Inc. New York (1996).
2. H-D Belitz, W Grosch and P Schieberle: Food Chemistry - 3rd Edition (2004) Springer Verlag March 2004
3. John M Demann: Principles of Food Chemistry AVI Publishing Co, West port, USA 1974
4. Zdzislaw E. Sikorski: Chemical and Functional Properties of Food Components Technomic Publishing, Lancaster, USA 1997

Reference Books:

1. Eskin, N. A. With Henderson, H. M : Biochemistry Of Foods Harcourt Publishers Ltd, USA (Edition #2, 1990)
2. David S.Robinson: Food Biochemistry and Nutritional Value Longman Scientific and Technical Publishers, USA (1987)
3. J.B.S.Breverman: Introduction to Biochemistry of Foods Elsevier Publishing Company, USA (1963)
4. Pieter Walstra: Physical Chemistry of Foods Marcel Dekker Publishing, New York (2003)
5. Zd Zislaw and E.Sikroski: Chemical and functional Properties of Food Components: Technomic Publishing company, USA (1997)
6. T.P.Coulate: Food – Chemistry of its Components Royal Society of Chemistry, USA (1984)

FP303 FOOD TECHNOLOGY – I

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Technology of Fruit and Vegetable Processing - 1
Climacteric and Non-climacteric fruits – Overview of processing technologies including pickling, Jam, Juice, and Concentrates, RTS beverages, Sauce manufacture
Minimal processing of Fruits and Vegetables – MAP and CAP – High Pressure processing – Edible coatings – Osmotic dehydration – Fruit and Vegetable dehydrations – Fruit and Vegetable powders – Quality control

Unit II: Cereals and Pulses Technology
Milling of Cereals – Rice, Wheat, Maize, Sorghum, Oats, Barley

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Parboiling of rice – Products from rice – Convenience food products from rice
Maize – Processing of maize – Tortillas
Quality control

Unit III: Baking and Extrusion technology
Manufacture of Baked products (Chemistry and Technology) – Process of bread manufacture –Cake manufacture – Pastries – Recent developments - Extrusion of cereal flours – Pasta and Noodle manufacture - Quality control

Unit IV: Technology of Plantation products:
Tea, Coffee and Cocoa (Chemistry and Technology) — Process for manufacture of CTC and Green tea, Instant tea, Instant coffee - Cocoa processing – Fermentation, Manufacture of cocoa powder, chocolates

Unit V: Chemistry and Technology of sugar products and beverages – Alcoholic and Non-alcoholic
Sugar – Process for the manufacture of sugar – Grading of sugar – Quality control aspects
Process for the manufacture of confectionery products - Manufacture of carbonated beverages – Recent developments - Chemistry and Microbiology of Beer and Wine - Manufacture of distilled spirits

Text books:

1. Street C.A. Flour Confectionery Manufacture, Blackie and Son Ltd., VCH Publishers Inc. Newyork, 1991.
2. Dendy D.A. and Dobraszczyk B.J. Cereal and Cereal Products – Technology and Chemistry (Food Products series), Aspen Publication, USA (2001).
3. E.B. Jackson: Sugar Confectioney Manufacture, Second edition, Aspen publishers Inc., Great Britain,1999.
4. Minifie Bernard W., Chocolate, Cocoa and Confectionery Technology, III Edition, Aspen Publication, 1999.
5. Varnam A. and Sutherland J.M. Beverages : Technology, Chemistry and Microbiology, Aspen publishers Inc., Great Britain,1999.

FP304 FOOD ADDITIVES

Credit : 3:1:0 **Marks : 40 + 60**

Unit I :
Introduction – food additives definition – Determination of the limit for addition – NOEL – Toxicity data – Method of determining toxicity – LD50, carcinogenicity, teratogenicity – PFA, FDA, FPO regulations – GRAS additives

Unit II:
Types, chemical properties, levels of additions in individual products, toxicity data of Acidulants – Preservatives – Emulsifiers and gums - Antioxidants

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Unit III:
Types, chemical properties, levels of additions in individual products, toxicity data of Dough conditioners - flour improvers – Humectants –Enzymes, Starches

Unit IV:
Types, chemical properties, levels of additions in individual products, toxicity data of Colourants – Natural and artificial, Flavourants, Flavour enhancers, Fat substitutes and replacers

Unit V:
Types, chemical properties, levels of additions in individual products, toxicity data Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives

Text book:
1. Food additives by Brannen A.L., Davidson P.M., Salminen S. and Thorngate J.H. Second Edition, Revised and Expanded. Marcel dekker Inc. USA, 2002.
2. Handbook of Food additives by Thomas Furia,

FP305 FOOD ENGINEERING - I

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Introduction:
Basic principles of food processing, Conservation of mass and energy, Units and dimensions of engineering parameters - Dimensionless ratios and calculations involving various physical parameters - Significance of Reynold's number, Peclet number, Nusselt number, Grashof number and Fourier number - Dimensional analysis by Rayleigh's method and Buckingham pi- theorem

Unit II: Fluid flow theory and applications:
Fluid statics, pressure dynamics, Bernoullie's equation, Newtonian and non Newtonian fluids, Laminar and Turbulent flow, friction losses in pipes valves and bends, Simple calculations - Flow measuring devices – Orificemeter, Venturimeter, Rotameter, Pitot tube, the Nozzle, the Notch or weir, hot wire anemometer

Unit III: Mechanical and Centrifugal separations;
Filtration and sedimentation, gravity sedimentation. Examples Industrial applications and equipments for Filtration and Sedimentation - Centrifuges, Basic equations. Different types of centrifuges – Basket, Tubular Bowl, Decanting, Disk bowl, Desludging (Self Cleaning) Bowl Centrifuges, Nozzle centrifuges. Importance of balancing of rotating masses, feed and discharge arrangement in each case - Specific characteristics, advantages and applications.

Unit IV: Membrane Filtration:
Definitions; Reverse Osmosis (RO), Nano filtration (NF), Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.

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Unit V: Roasting and Cooking:
Theory, Different kinds of Roasters, Steam Cookers. Extrusion cooking. Single and Twin Screw Extruders. Forming extruders and snack food extruders. Advantages of Extrusion cooking over conventional cooking.

Text Books

1. P. Fellows : Food Processing Technology: Principles and Practice, Second Edition, Woodhead Publishing Limited, 2000.
2. R.L.Earle: Unit Operations in Food Processing, (II Edition or later), Pergamen Press, New York
3. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering- Vol 2 Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.
4. Brennen: Food Engineering Operations (Vol 1 and 2), Elsevier Publishing Maynord Joslyn and J.L.Heid:
5. Food Processing Operations (3 Volumes) AVI Publishing company Inc. USA 1986

Reference Books

1. Rakesh Singh and S.H.Rizwi: Bio Separation Process in Foods, Marcel Dekker Inc. Hong Kong
2. G.M.Schneider, E. Stahl and G.Wilke: Extraction with Supercritical Gases, Verlag Chemie publishing, Basel
3. F.J. Fryer, D.L. Pyle and C.D. Rielly: Chemical engineering for the Food Industr, Blackie Academic and Professional, London, Chennai
4. Jimmy L. Humphry and G. E. Keller: Separation Process Technology, Mcgraw Hill New York
5. A.S.Grandison and M.J.Lewis: Separation processes in the Food and Biotechnology industries (Principles and applications): Woodhead publishing Ltd. Cambridge UK

FP306 FOOD ENGINEERING-II

Credit : 3:1:0 **Marks : 40 + 60**

Unit I:
Distillation and Adsorption: Distillation, Steam distillation, applications and equipment. Molecular distillation, theory and examples. Mass transfer phenomenon applied to food systems - Basics of adsorption, Diffusion of gases in liquid and solid foods

Unit II: Evaporation:
Needs, basic principles, Calculations, Single and multiple effect evaporation, Heat economy, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit III: Dehydration:
Principle of dehydration – Theories of drying – Drying curves – Constant and falling rates of drying of foods - Prediction of drying time - Dehydration systems – Tray or tunnel dryers – Spray driers, Fluidised bed driers, Freeze driers

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Unit IV:

Contact equilibrium separation processes: Basics of Solid-liquid extraction processes, liquid-liquid extraction extraction, with food application examples, Crystallization

Super critical fluid extraction: Super critical Fluid State, Properties of Super critical CO_2, Density, Viscosity, Volatility etc. Supercritical Phase Equilibria, Solubility, Mass transfer operations, SCFE systems and components, Applications; extraction of Fatty acids, Hops, Essential oils and Bio chemicals; Relative advantages, limitations and economics

Unit V: Food Freezing

Basic principle – Factors influencing freezing of food products - Direct and Indirect Contact freezing systems – Plank's equation – Prediction of freezing time – Modelling thermal properties of frozen foods - Experimental measurement of freezing time - Thawing

Text Books:

1. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering- Vol 2 Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.
2. H.A.Lenigar and W.A.Beverlo: Food Process Engineering, D.Reidal Publishing Co, Boston, USA
3. R.L.Earle: Unit Operations in Food Processing, (II Edition or later), Pergamen Press, New York

Reference Books:

1. Albert Ebarz: Unit Operations in food Processing, CRC Press
2. Marcus Karel & Deryl B Lund: Physical Principles of Food Processing, Marcel Dekker Inc.
3. H.S. Ramaswamy & M. Markotte: Food Processing Principles and Applications, CRC Press Ltd.
4. Dennis R. Heldman and R. Paul singh: Food Process Engineering (II Edition), AVI Publishing Company Inc. (1981)
5. Zacharias B. Maroulis and G. D. Saravacos: Food Process Design Marcel Dekker, USA (2003)

FP307 FOOD TECHNOLOGY – II

Credit : 3:1:0 **Marks : 40 + 60**

Unit 1: Dairy Technology -1

Milk – Physical and Chemical properties of milk – Milk microbiology - Importance of constituents in maintaining emulsion characteristics – Processing of milk – Standardised, Toned milks, Pasteurisation – HTST, Process – Sterilisation of milk – Process - Milk powder – Dairy whiteners - Manufacture of Icecreams and Frozen Desserts – Physical chemistry of Icecreams – Simple problems – Process for the manufacture of icecreams – Defects in Icecreams

Unit II: Dairy Technology – II

Chemistry, Microbiology and Technology of Cheese, Butter, Yoghurt, Dahi, Whey products – Quality control

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Unit III: Technology of Meat Fish and Poultry products - 1
Chemistry and Nutritive Characteristics of Various meat - Components of meat and their properties – Lean meat, Mechanically separated meat, head meat, Connective tissures and Offals - Eggs – Processing principles – Moisture retention – Fat retention – Meat binding – Curing – effects of curing ingredients – Colour and Flavour of mear – Microbiology - Chilling and freezing – Cooking

Unit IV: Technology of Meat, Fish and Poultry products - 2
Comminuted meat products – cured meats – Bacon and Ham – Luncheon meats - Sausages Canning and Dehydration, curing and Smoking – Irradiation - Eggs – Processing – Liquid eggs, Pasteurisation, Egg white - Methods of analysis and quality control of Meat and egg products

Unit V: Technology of Spices and condiments:
Pepper, Cardamom, ginger and turmeric, Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identicals - Quality control - Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

Text Books:

1. Edgar Spreer, Milk and Dairy Product Technology (Food Science and Technology), CRC Press, 1998.
2. Mountney G.J. and Parkhurst R.C. Poultry Products Technology, 3rd Edition, Food Products Press Inc., NY, 1995
3. Ranken Michael D. and Ranken M.D. Handbook of Meat Product Technology, Blackwell Science, U.K. 2000.
4. Peter K.V. Handbook of herbs and spices, Woodhead Publishing Ltd., CRC Press, England, 2004.

FP308 NON-THERMAL METHODS OF FOOD PRESERVATION

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Ionizing Radiations:
Concept of radiation, definitions, ionization and excitation, radiations for treating foods, interaction of ionizing radiation with food matter, quantitative relationships. Radiation chemistry basics, primary chemical effects and secondary effects on good. G value, role of irradiation parameters, dosage dose rate, water content, temperature, additives, post irradiation effects, times for various radiation events.

Unit II: Radiation chemistry of food components
Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds. Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

Karunya University

Unit III: Microwaves in food processing
Electronic heating terminology, microwave energy, nature of energy, batch and continuous ovens, conveyorized ovens, microwave generators, wave guides, brief description of oven construction, Industrial application of microwave radiation, dielectric properties and radiation, Applications in dehydration, baking, blanching, thawing, pasteurization/ sterilization and processing of meat products.

Unit IV: Infra red radiation
Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation. Propagation of IR radiation in food stuffs. IR generators, Radiation equipment, Instruments for measuring Radiation. Some applications in food technology. Relative merits and demerits of IR radiation over other radiations.

Unit V: Radio frequency heating principles
Advantages of Radio frequency heating of foods. RF heating equipment including conveyorized dryers. Ultra violet radiation and its effect on microorganisms in foods. UV treatment application and equipment.

Text Books:

1. Welter M. Urbain: Food Irradiation Academic Press, New York (1986)
2. Wilkinson Guild: Food Irradiation – A Reference Guide Woodhead Publishing, Cambridge, UK (1996)
3. J.F.Diehl: Safety of Radiated Foods Marcel Dekker Inc. NY (1995)
4. Robert V. Decareau: Microwaves in Food Processing Industry Academic Press inc. New York (1985)
5. Ohlsson and Bengtson: Microwave Processing Technologies Woodhead Publishing, Cambridge, UK (2002)
6. S.G.Llyasor and V.V. Krasnikov: Physical Principles of Infra Red Irradiation of Food Stuffs: Hemisphere Publishing Corporation, London (1991)
7. Philip Richardson: Thermal Technologies for Food Processing Woodhead Publishing Limited, CRC Press. (2001)

FP309 FOOD PACKAGING TECHNOLOGY

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Introduction to food packaging:
Protection of Food products as major role of food packaging: Functions of packaging, Effect of environmental factors on food quality and shelf life, Need for protective packaging, effect of light, Oxygen, Moisture, Temperature, mechanical forces and biological factors on quality of food. Estimating the Shelf life requirement of food products for packaging, General Approach, analysis of storage requirement, accelerated storage studies: Vacuum and Inert Gas Packaging: Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

Unit II:
Metal Cans as packaging; Merits and demerits, Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Relative merits and demerits. Basics of Canning operations,

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Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used.

Unit III: Flexible films packaging:
Relative merits and demerits. Formation of Films and pouches, Plastics used and their Specific applications, advantages and disadvantages – Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Poyvinylidene Chloride (PVDC - Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications. Co-extruded films and Laminates Their applications. Filling (Volumetric and Gravimetric) and Sealing of pouches, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging –Fabrication methods in brief –Thermo forming, Blow moulding, Injection moulding, Extrusion
Extrusion Blow moulding etc., applications: Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging and their applications.

Unit IV:
Filling and Sealing operations for various types of packages. Can double seam, can seam formation and defects, terminology, Metal caps for bottles and jars – Crown corks, lug caps, Twist off lid and ROPP caps, Description and applications. Closing and sealing of Rigid plastic containers. Filling and sealing of Flexible plastic containers, Seal types-Bead seals, Lap Seals and Fin seals –Differences and advantages, Hot wire sealing, hot bar sealing and impulse sealing – differences and relative advantages, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements.

Unit V:
Interaction of food material with packaging material. Active packaging, Moisture control, CO_2 and Oxygen scavenging, Modified atmosphere packaging – principles, applications.

Text Books:

1. Gordon L. Robertson: Food Packaging- Principles and Practice, Second Edition, CRC Press, Taylor and Francis Group, 2006.
2. Donald Downing: Complete Course in Canning (3 Volumes) CTI Publications inc, USA (1996)
3. Mathlouthi M. (Editor): Food Packaging and Preservation Aspen Publication, 1999.
4. M.L.Rooney: Active Food Packaging : Blackey Academic and Professional, London (1995)
5. Shirly V.Vangrade and Morgy Woodburn: Food Preservation and Safety Surabhi Publications, Jaipur India
6. J. R.D.David, R. H Graves and V.R.Carlson: Aseptic Processing and Packaging of Foods: CRC Press, New York

Reference Books

1. NIIR Board: Food Packaging Technology Handbook National Institute of Industrial Research, New Delhi (2004)
2. Frank A. Paine and Heather Y.Paine: A Hand Book of Food Packaging Second Edition, Blackie Academic Profesional, Madras, 1995.
3. O.G.Pirenger and A.L.Baver: Plastic Packaging Materials for Food Wiely VCH, GmbH, Germany (2000)

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4. J Ralph Blanch Field (Ed.): Food Labelling Woodhead Publishing Inc. CRC Press USA (2000)
5. Irwin A.Taub, R. Paul Singh: Food and Storage Stability CRC Press, USA (1997)
6. David Kilcast & Persis Subramaniam: The Stability and Shelf Life of Food Woodhead Publishing Limited, CRC Press (2000)
7. Aaron L. Brody: Controlled/Modified Atmosphere/Vacuum Packaging of Foods Food And Nutrition Pres, USA (1989)
8. R.T.Parry: Principles and Applications of Modified Atmosphere Packaging of foods: Blackey Academic and Professional, London (1993)

FP310 ANALYSIS OF FOOD CONSTITUENTS LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

FP311 ENZYMOLOGY LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

FP312 FOOD AND CHEMICAL ENGINEERING LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

FP313 FOOD PROCESSING AND PACKAGING LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

FP314 PROTEIN CHEMISTRY AND ENGINEERING FOR FOOD ENGINEERS

Credit : 3:1:0 **Marks:40+60**

Unit I: Basics of amino acids and protein chemistry

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis - Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls

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interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

Unit II: Protein Architecture

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine

Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

Unit III: Protein Engineering

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, de novo protein design.

Unit IV: Properties of Food proteins – Animal and Marine sources

Caseins and Whey proteins

Caseins – Heterogeneity and Molecular properties – caseins micelles – Mechanism of stabilization – Structure models – Structure of whey proteins and improvement of functionality

Muscle proteins – Structure and functionality – Application of muscle proteins in foods

Sea weed proteins – Protein content and functionality, digestibility of algal proteins – applications to food systems

Unit V: Properties of Food proteins – Plant sources

Compostion, Properties and functional properties of soya, rapeseed**,** peanut - Leaf as a protein soure – Basic and Food applications of rubisco

Text Books:

1. Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999
3. P. F. Fox, J. J. Condon. Food Proteins, Kluwer Science, 1982.
4. B. J. F. Hudson. New and Developing Sources of Food Proteins, Chapman and Hall, 1994.
5. Zidzisław E. Sikorski, Chemical and Functional Properties of Food Proteins, CRC Press, 2001.

Reference Books:

1. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
2. Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1999

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FP315 DESIGN AND ANALYSIS OF HEAT TRANSFER EQUIPMENTS

Credit :3:1: 0 **Marks: 40+60**

Unit I:
Introduction, classification of heat exchangers, Arithmetic mean temperature difference(AMTD),logarithmic mean temperature difference(LMTD)-parallel flow and counter flow, overall heat transfer coefficient, fouling in heat exchangers-fouling effect calculations. Effectiveness in heat exchangers- parallel flow and counter flow .Number of transfer unit (NTU).

Unit II:
Design of shell and tube heat exchangers: Design considerations, overall heat transfer coefficient .Baffles in heat exchangers –types, baffle spacing. Shell types, tube bundle, pitch. Pressure drop and pumping power calculations - Heat transfer in reaction vessels-Helical cooling coil, jacketed vessels. time required for heating or cooling

Unit III:
Design of condensers – Economic selection of condensers. Types-Direct contect, surface condensers. Vacuum efficiency –Air leakage into the condenser-air removal-dry, wet pumps. Design of condensers for Thermal power plant and refrigeration circuits.
Cooling tower-Types and design of natural and mechanical draught towers; Temperature and humidity gradients in water Cooling tower; humidifying tower

Unit IV:
Economiser-types, design. Super Heater –Design, Economy of super heat limit of super heat, super heater performance, steam mass flow gas mass flow and pressure drop in super heater. Super heat temperature control. Desuperheater-design.Design of Reheater.Air Pre-Heaters: Types of Air pre-heater, recuperative and regenerative

Unit V:
Evaporators –classification-horizontal and vertical. Single effect and multi effect evaporator criteria for selecting evaporator. Design of Evaporators for refrigeration circuits and Food plants.

Text Books:

1. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi,1998.
2. Sadik Kakac and Hongtan Liu, "Heat exchangers" ,CRC press,1996.

Reference Books:

1. Kays, W.M. and London A.L., 'Compact Heat Exchangers', 3rd Ed., McGraw Hill, 1984.
2. Frass, A.P. and Ozisik, M.N., 'Heat Exchanger Design', John Wiley and Sons Inc., 1965.
3. Wlker G., 'Industrial Heat Exchangers', A basic guide, McGraw Hill V Book Co., 1980.

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FP316 SPRAY DRYING: APPLICATION IN THE FOOD INDUSTRIES

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Spray drying fundamentals
Applications spray drying process stages. Process lay out-Open, Closed, Semi-closed and two stage. Representation of sprays- Mean diameter. Various types of atomizers used in spray drying industries-working principles.

Unit II: Drying Principles
Wet bulb, Dry bulb temperatures, and relative humidity. Enthalpy-Humidity chart application to Spray Drying. Heat and mass balance over spray dryers. Thermal efficiency (simple problems)

Unit III: Design of Spray Dryers
Importance of residence time. Specification and design procedures for Open and Closed cycle (simple problems)

Unit IV: Spray movement and drying of droplets in Spray Dryers
Motion of single Droplet, droplet deceleration from rotary and nozzle atomizers, terminal velocity and drag coefficient .Evaporation of pure liquid droplet-evaporation rate. Evaporation time. Evaporation of droplets containing dissolved solids and insoluble solids. Size difference between product before and after drying-separation and recovery of dried products. (simple problems)

Unit-V: Application in the food industry-
Food products and Plant extracts, milk products-eggs, fruits and vegetales, fish industries.

Text Book:

1. K.Masters ., "Spray drying handbook" John Wiley and sons, New York, Third edition

Reference Books:

1. L.Bayvel, Z.Orzechowski., "Liquid atomization", Taylor and Francis, United States of America, 1993.

FP317 ANALYSIS OF FOOD COMMODITIES LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

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ADDITIONAL SUBJECTS

Code	Subject Name	Credits
BT222	Bioethics, IPR and Biosafety	4:0:0
BT223	Plant Biotechnology	4:0:0
BT224	Applied Plant and Animal Biotechnology	4:0:0
BT225	Introductory Genomics and Proteomics	4:0:0
BT226	Nano Biotechnology	4:0:0
BT227	Introductory Microbiology	4:0:0
BT228	Introductory Biotechnology	3:0:0
BT229	Introductory Cell Biology	4:0:0
BT230	Introductory Genetic Engineering	4:0:0
BT231	Role of Biotechnology in Environment	4:0:0
BT232	Basics of Biomolecules	4:0:0
BT233	Gene and Gene Expression	4:0:0
BT234	Introductory Microbial Biotechnology	4:0:0
BT235	Applied Biotechnology	4:0:0
BT236	Mass Transfer Operations	4:0:0
BT237	Protein Engineering	4:0:0
BT238	Enzyme Engineering and Technology	4:0:0
BT239	Bioprocess Engineering	4:0:0
BT240	Immunology and Immunotechnology	4:0:0
BT318	Advanced Environmental Biotechnology	4:0:0
BT319	Advanced Plant and Animal Biotechnology	3:1:0
BT320	Anatomy and Physiology	4:0:0
BT321	Biochemistry and Human Physiology Lab	0:0:2
BT322	Pathology and Micro Biology	4:0:0
BT323	Hospital Management	4:0:0
BT324	Radiological Equipments	4:0:0
BT325	Diagnostic and Therapeutic Equipment	4:0:0
BT326	Computers in Medicine	4:0:0
BT327	Pathology and Microbiology Lab	0:0:2
BT328	Medical Physics	4:0:0
BT329	Biomaterials & Artificial Organs	4:0:0
BT330	Bio Reactor Design	4:0:0
BT331	Advanced Chemical Reaction Engineering	4:0:0
BT332	Molecular Biology & Genetic Engineering	4:0:0
MT333	Molecular Biology & Genetic Engineering Lab	0:0:2
MT334	Downstream Processing in Biotechnology	4:0:0

BT222 BIOETHICS, IPR AND BIOSAFETY

Credits: 4:0:0

Unit-I **Engineering ethics**

Senses of “Engineering Ethics”' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy –

Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories

Unit-II Environmental Aspects of Biotech Applications

Use of genetically modified organisms and their release in environment Special procedures for r-DNA based product production. Identification of directions for yield effect in agriculture, aquaculture etc, Bioremediation.

Unit-III Intellectual Property Rights

TRIPS, International conventions patents and methods application of patents, Legal implications, Biodiversity and farmers rights. Beneficial applications and development of research focus to the need of the poor.

Unit-IV Global Issues

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline), Biosafety.

Unit-V The Legal And Socioeconomic Impacts Of Biotechnology

Public education of the process of the processes of biotechnology involved in generating new forms of life for informed decision making Biosafety regulation and National and international guidelines r-DNA guidelines, Experimental protocol approvals, levels of containment

Text Books:

1. Sasson A, "Biotechnologies and Development ", UNESCO Publications, 1988.
2. Sasson A, " Biotechnologies in developing countries present and future ", UNESCO Publishers, 1993.

BT223 PLANT BIOTECHNOLOGY

Credits: 4:0:0

Unit I: Cell and Tissue Culture

Definition and need; Types of Methods in plant Biotechnology; Cell and Tissue Culture; Micro propagation; Callus Culture; Somatic Embryogenesis; Hairy Root Culture; Culture Medias.

Unit II: Plant Genetic Engineering Tools, Plant Vectors and plant Viruses

Vectors and Genetic Engineering; Agro bacterium mediated gene transfer and cloning; Agro bacterium types; Plant viruses and Genetic Engineered viruses as a tool of deliver foreign DNA; major plant viruses, CAMV, TMV, BBTV, Gemini viruses etc.

Unit III: **Application of Plant Biotechnology**

Hairy Root Cultures and Secondary Metabolite production; Plant as Bioreactors- edible Vaccines; Germplasm conservation; Gene Banks; Crop improvement; legume symbiosis, N_2 Fixation; Regulation of NIF and NOD Genes.

Unit IV: Molecular Aspects of Disease Susceptibility and Resistance
Transposable elements, factors influencing disease resistance and susceptibility RFLP

Unit V: **Transgenics**
Stress tolerance-Biotic and abiotic temperature, salinity, drought etc; Pests and insects resistance- viral resistance- development of disease resistance plants by introducing *Bacillus thuringiensis* genes.

Text and reference Books:

1. Mantal S.H., Mathew J.A.,Mickee R.A., *Principles of Plant Biotechnology*. An Introduction to Genetic Engineering in Plants, Blackwell Scientific Publication, 1985.
2. Marx J.L., *Revolution in Biotechnology*, Cambridge University Press, 1989.
3. Dodds J.H., *Plant Genetic Engineering*, Cambridge University Press, 1985.
4. Grieson, Plant Biotechnology.
5. Glick and Pasternak, Molecular Biotechnology.
6. R.K.Gupta., Introduction to Biotechnology.
7. R.C. Dubey and Maheswari. Introduction to Microbiology, 2002, S.CHAND.
8. Walker and Raplery, Molecular Biology and Biotechnology, Panima.2003.

BT224 APPLIED PLANT AND ANIMAL BIOTECHNOLOGY

Credit: 4:0:0

Unit –I Introduction
Biotechnology, Scope and Role of Biotechnology in third world countries, Biotechnology – basic needs of human beings (food, shelter & medicine)

Unit – II Plant Tissue Culture in Biotechnology
Organ Culture – Anther, Embryo and Endosperm culture and their applications Organogenesis and Somatic Embryogenesis – Techniques and applications. Protoplast Culture – Isolation, regeneration and viability test, somatic hybridization, methods of protoplast fusion –chemical and electro fusion, practical application of somatic hybridization and cybridization. plant cell cultures for the production of useful chemicals : pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds. Role of tissue culture in agriculture, horticulture and forestry. Applications of transgenic plants. Edible Vaccines from plants – Banana, Watermelon. Herbicide resistance and stress tolerance in plants, Bioinsecticdes and Biofertilizers .

Unit – III Plant Genetic Engineering
In-vitro Methods in plant tissue culture, Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokinin and Gibberellins).In-Vitro fertilization – Ovary and Ovule culture. Clonal Propagation of elite species (Micro Propagation).Somaclonal Variation and their significance. *In-Vitro* production of secondary metabolites – Techniques and significance. Transgenic plants Technique of transformation – Agrobacterium mediated and physical Methods. Microprojectile and electroporation)

Unit – IV Animal Cell Culture and Gene Cloning in Biotechnology

Culture Media for growth of animal cells 1. Natural media –Plasma Clot, biological fluids tissue extract, Importance of Serum in media 2. Chemical defined media a) Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. b) Secondary Culture – transformed animal cells and continuous cell lines transfection of animal cell lines. HAT selection, Selectable Makers and Transplantation of Cultural Cells. In vitro fertilization and embryo transfer, AIDS, cancer – oncogenes, proto – oncogenes and tumor suppressor genes. Vaccines and hormone signal transduction.

Unit – V Animal Genetic Engineering

Techniques for gene transfer in animals, xenotransplantation, patenting genetically engineered animals, mapping of human Genome, intellectual property Rights (IPR) and patenting Biotechnology and Intellectual property rights Patents, trade secrets, copyright, trademark, choice of Intellectual property (IPr) and plant genetic resomes (PGr) , GAA TRIPS, Toxicology ,Basics of Biological Patenting, International Depositories and their Interlink, Phytoxicity, LD50, LC50, LT50, Dermal, Mucous, Eye, Reproduction, Neurobehaviour, Carcinogenicity and Mutagenicity.

Text Books

1. Bojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier, Amsterdam
2. Doyle, A.R. Hay and B.E. Kirsop 1990 Living Resources for bio technology Cambridge University press, Cambridge
3. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.
4. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut.
5. S.Ignacimuthu.S.J. (2004). Plant Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd.

Reference

1. Ravishankar G.A and Venkataraman L.V (1997) Biotechnology applications of Plant Tissue &cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi.
3. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropogation (3rd Edition) timber Press, Partland.
5. Kumar H.D (1991) A test book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
6. Chrispeel M.J. and Sdava D.E. (1994 Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
7. Reinert J. and Bajaj Y.P.S (1997) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishing House.
8. Grierson.D. and S.N. convey : plant Biotechnology in Agriculture
9. Dodds J.H., *Plant Genetic Engineering*, Cambridge University Press, 1985.
10. Grieson, Plant Biotechnology.
11. Glick and Pasternak, Molecular Biotechnology.

12. R.K.Gupta., Introduction to Biotechnology.
13. R.C. Dubay and Maheswari. Introduction to Microbiology, 2002, S.CHAND.
14. Walker and Raplery, Molecular Biology and Biotechnology, Panima.2003.

BT225 INTRODUCTORY GENOMICS AND PROTEOMICS

Credit : 4:0:0

Unit I:
Overview –Variation and regulation in Prokaryotic & Eukaryotic genome expression profile– Brief outlook of various genome projects and their outcome. Nucleotide & protein sequencing methods – Chemical, enzymatic, high through put method – Automated sequencing methods

Unit II:
Various Approaches in sequencing genome – shotgun, directed short gun & Clone contig approach – Primer walking, chromosome walking, chromosome jumping, Contig assembly, Genome Marking and mapping techniques

Unit III:
Mapping and sequence assembly – genetic marker– Physical Marker –, Radiation hybrids – Sequence markers. Expression analysis – micro array approach, Human Genome Project - Transcriptome– structural & functional Genomics – comparative & population genomics- Pharmacogenomics – Phylogenetics.

Unit IV:
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.

Unit V:
Proteome databases: protein sequence database, SWISS-PROT, TrEMBL, specialized protein sequence databases, PROSITE, BLOCKS, 2-D PAGE databases, PDB, genomic databases, OMIM, Metabolic databases, Some specific metabolic databases

Reference:
1. T.A Brown , Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002.
2. Pennington, Proteomics from Protein Sequence to Function, 2nd edition, Viva Books Ltd, 2002
3. David W Mount, Bioinformatics: sequence and genome analysis, 2nd edition, CBS publishers, 2004

BT226 NANOBIOTECHNOLOGY

Credit: 4:0:0

Unit I

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Visions and Objective of Nanotechnology, Nanotechnology in Different, Fields: Automobile, Electronics, Nanobiotechnology, Materials, Medicine, Dental care, Nanocomputers, Power storage, Nanotechnology products Latest Developments in Nanotechnology.

Unit II

Nano Particles :Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

Unit III

Application: Nanomedicine, Nanobiosensor and Nanofluids. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for *in vivo* drug delivery- Future nanomachine.

Unit IV

Nanobiotechnology: Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nanocarbon tubules. Nanosurgical devices.

Unit V

Ethical Issues in Nanotechnology: Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With special Reference to Nanomedicine, Nanomedicine Applied in Non-medical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic Challenges

References

1. Nanobiotechnology: Concepts, Applications and Perspectives. Edited by Christof M. Niemeyer, Chad A. Mirkin. Wiley-VCH, 2006.
2. Biomolecular Computation by Nanobiotechnology. Jian-Qin Liu, Katsunori Shimohara. Artech House, 2007.
3. Nanoscale technology in Biological Systems. Ralph S. Greco. CRC Press. 2005.
4. Handbook of Nanostructural Biomaterials and Their Applications in Nanobiotechnology. Hari Singh Nalwa. American Scientific Publishers.2005.
5. Nanotechnology: Volume 5: Nanomedicine and nanotechnology. Edited by Viola Vogel. John Wiley & Sons Limited, 2008.

6. Nature Biotechnology Volume 21, No. 10, 2003
7. Scientific American Volume 285 No. 3, September 2001
8. Ratner M, Ratener D (2003) Nanotechnology- A Gentle Introduction to the Next Big Idea, Prentice Hall, ISBN :031014005
9. Nanotechnology:A Gentle Introduction to the Next Big Idea by Mark Ratner and Daniel Ratner, 2002
10. Nanophysics and Nanotechnology, E.L. Wolf, Wiley 2006
11. Nanotechnology in Biology and Medicine: Method , Devices and Applications by Tuan Vo Dinh, CRC Press 2007
12. The Chemistry of Nanomaterial: Synthesis,Properties & Applications,Vol I &II by CNR Rao, Springer 2006

References:

Singh K. "Intellectual Property Rights on Biotechnology ", BCIL, New Delhi.

Free Electives

BT227 INTRODUCTORY MICROBIOLOGY

Credits: 4:0:0

Unit I

Definition and scope of Microbiology - History and recent developments - spontaneous generation - Biogenesis-contributions of Louis Pasteur - Leewenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister - Robert Koch, Culturing methodology and sterilization techniques.

Unit II

Anatomy of prokayotes and eukaryotes - structure and function of cell wall, cilia, flagella, slime layer, capsule, pili, cytoplamic membrane and cytoplasmic inclusions, sporulation. Microbial Nutrition and syntesis of important biological molecules

Unit III

Microscopy: simple, compound light microscopy - Dark ground - Phase contrast - Fluorescence and Electron Microscopy. Microbial kingdoms - Five kingdoms - cell theory - Binomial nomenclature of microbes - species concept - Description of organisms - Classical approach with examples.

Unit IV

Host microbe interaction, bacterial, viral, fungal pathogens, Antimicrobial chemotherapy - Antibiotics - source - classification - mode of action - Antimicrobial resistance - Tests for sensitivity to antimicrobial agents and its quality control.

Unit V

Microbes in soil, Nitrogen-fixing, nitrifying and denitryfying bacteria. Sulphur bacteria. Biofertilizers. Sewage disposal and treatment-Physical and biological.Microbes in air. Methods of purification of air. Preservation of food, Microbes in the production of

organicacids – Lactic acid, antibiotics -Penicillin and alcoholic beverages – Beer and Wine, Vitamins – Cyanocobalamin, Enzyme – Amylase

Text Book

1. Pelczar MJ, Chan ECS And Krein NR, *Microbiology*, Tata McGraw Hill Edition, New Delhi, India.
2. Prasad B.N., *"A Text Book of Biotechnology"*, (2003) Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.

References

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 1993.

BT228 INRODUCTORY BIOTECHNOLOGY

Credit 3:0:0

Unit – I

Definition – Scope – Biotechnology in India – Applications of biotechnology: disputed parenthood, criminology & taxonomy.

Unit – II

Principles and Methods of gene cloning – application.Gene cloning vectors – Plasmids PBR 322, BUC 8 – cosmids PLFR 5, PJB 8 – SV40, BPV – their salient features and uses – enzymes in gene cloning – transfection - amplification – expression vectors.

Unit – III

Transgenic plants – herbicide, insecticide and virus resistant plants – Transgenic animals mice, cattle, fishes and poultry. Socio-economic issues of Biotechnology.

Unit – IV

Integrated nutrient supply and IPM system, Biological nitrogen fixation – basic requirements – symbiotic and nonsymbiotic nitrogen fixation – production and application of rhizobium as a biofertilizer – production and application of ethanol as bio--fuel, Phosphorous, Potash, Sulphur – Solubilization.

Unit – V

Gene Banks – importance – DNA finger printing – methodology and application –methods of gene therapy – biosensors – types and application of biochips, Biological Databases and Websites.

Reference Books:

1. Balasubramania. D. 1996. Concepts of Biotechnology, University Press (India) Ltd., Hyderabad.
2. Chopra, U.L. and Narim. A. 1996. Genetic Engineering and Biotechnology. Oxford & IBH, New Delhi.
3. Dharmarajan, M. 1989. Genetic Engineering. S. Viswanathan & Co.

4. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.
5. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut.
6. Kumar H.D. 1993. A Text book of Biotechnology. East West Affiliated Press.
7. Trevan, M.D. 1993. Biotechnology. The Biological Principles. Tata Mc Graw Hill Publishing Co., New Delhi.
8. Arumugam. Biotechnology. Saras Publications.
9. Vijayaraman, Chellammal K.S and Manikkili. P. 1998. Uyiriyae Thozhilnutpam. Chimeeraa, Trichy.

BT229 INTRODUCTORY CELL BIOLOGY

Credits: 4:0:0

Unit I Cell Structure And Functions Of Organelles
Eukaryotic and Prokaryotic cells – Principles of membrane organization – membrane proteins (Internal and external) – Cytoskeletal proteins – extra cellular matrix.

Unit II Cell division – mitosis and meiosis – cell cycle and factors that control cell cycle.
Structure, Organization & reproduction of bacteria, yeast, fungi, algae, bacteriophage, plant viruses and animal viruses.

Unit III Transport Across Cell Membranes
Passive and active transport – permeases – sodium – potassium pump ,Toxins and their mode of entry into cell. (Cholera and Diphtheria).

Unit IV Receptors And Models Of Extra Cellular Signaling
Cytosolic – Nuclear and membrane bound receptors Autocrine, paracrine and endocrine models of action – Quantitation and characterization of receptors

Unit V Signal Transduction
Signal amplification pathways, cyclic AMP, role of inosital phosphates, cyclic GMP, G proteins and calcium ion role in cell signaling, phosphorylation of protein kinases.

Text Books
Dornel J. Lodish H, Baltimore D. “Molecular Cell Biology”, W.H. Freeman, 1990
Kimball I.W., “Cell Biology”, Wesely Publishers, 1989.

Reference Books
Gerald Karp and Nancy L Puritt, “Cell and Molecular Biology - Concepts and Experiment”, John Wiley and Sons, Inc, 1998.
De Robertis, E.D.P and De Robertis, E.M.F., “Cell and Molecular Biology” 6th Edition, Saunders College, Philadelphia, 1990.
Wolfe, Stephen L., “Molecular and Cellular Biochemistry”, Wadsworts, Inc. California, 1999.

BT230 INTRODUCTORY GENETIC ENGINEERING

Credits: 4:0:0

Unit I Basic Tools In Genetic Engineering

Restriction enzymes-Classification-nomenclature; Ligases-Modifying enzymes; Probe preparation-Radioactive labels-nonradioactive labels-Different labeling methods; Southern hybridization-Northern hybridization; Autoradiography; PCR-different kinds-Application; DNA sequencing; DNA finger printing-RFLP Analysis-chromosome walking.

Unit II Cloning Vectors-Prokaryotes

Plasmid biology-Plasmids as vectors- PBR322- Derivatives of pBR 322- pUC vectors-Other artifical plasmids-Phage-Lifecycle-M13-Lambda phages-Invitro packaging-Cosmids-Phasmids-Cloning vectors in Gram positive bacteria- Cloning vectors in streptomycetes

Unit III Cloning Stratergy

Construction of recombinant DNA: Preparation of competent cell-Transformation, transfection-Recombinant selection and sereening; Genomic DNA library; cDNA synthesis strategies -Linkers-Adapters-Homopolymer tailing; cDNA library.

Unit IV Expression Vectors

Eukaryotic cloning vectors-Prokaryotic expression system-Eukaryotic expression vectors-Yeast expression system-Retroviral vectors-Bacullovirus, Mammlian cells-SV40; Gene transfer techniques.

Unit V Gene Modification & Application Of Recombinant Dna Technology

Mutagenesis-Deletion mutagenesis, Oligonucletoide derived mutagenesis, Site directed mutagensis-Its applications; Applications of rDNA technology in Diagnostics; Pathogensis; Genetic diversity; Therapeutic proteins-Vaccines

Text Books

1. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.
2. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut.

Reference Books

1. Genetic Engineering by Nicholas.
2. Gene Cloning by T.A.Brown
3. Old R.W.Primrose SB, “Principles of Gene Manipulation, An Introduction to Genetic Engineering- Backwell Scientific Publications

BT231 ROLE OF BIOTECHNOLOGY IN ENVIRONMENT

Credits: 4:0:0

Unit I: Environmental pollution and social Issues

Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal. Pollution, control measures.

Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.

Unit II: Industrial Waste Water Management
Purification of waste water; Aerobic and anaerobic treatments; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.

Unit III: Biomass, Energy and Solid waste Management
Biomass waste as renewable source of energy; Methods of energy production; Conversion of Solid Waste to Methane; Biogas production; Biofuels, Management of Sludge and Solid waste treatment- Land filling, lagooning, Composting and Vermi Composting.

Unit IV: **Biodiversity and Conservation**
Definition, Types, Genetic, Species, Ecosystem; Biodiversity at Global Levels; Values of Biodiversity; Hotspots in Biodiversity; Loss of Biodiversity and its causes threats to Biodiversity; Biodiversity and its Conservation- In situ and Ex situ, IPR and Patenting.

Unit 5: Bioremediation and Biodegradation
Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation.

Text and Reference Books:

1. Indu shekhar Thakur, 2006. Environmental Biotechnology- Basic concepts and Applications.
2. Foster C.F; Johnware D.A, 1987. Environmental Biotechnlogy.Ellis Harwood Ltd.
3. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.
4. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut.

BT232 BASICS OF BIOMOLECULES

Credits: 4:0:0

Unit I: **Structure and Properties of Carbohydrates and Lipids**
Structure and properties of mono, di, oligo and polysaccharides, Structure, classification and properties of fatty acids, phospholipids, sphingolipids, glycolipids, lipoproteins and steroids.

Unit II: Structure and Properties of Proteins and Nucleic Acids
Structure, classification, and properties of amino acids and proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, ribonucleic acids, deoxy ribonucleic acids.

Unit III: **Intermediary Metabolism and Bioenergetics**
Carbohydrate Metabolism: Glycolysis, TCA cycle, gluconeogenesis, glycogenesis, glycogenolysis pentose phosphate pathway, Urea Cycle. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation .

Unit IV: Enzymes and Vitamins
Classification, properties, diagnostic and therapeutic applications of enzymes.

Vitamins: Classification, functions, dietary sources, daily requirements and clinical orientation of water soluble and fat soluble vitamins

Unit V:Hormones

Hormones: Classification, biochemical action and biochemical functions of estrogen, androgen, calcitrol (group I hormones), cAMP, FSH and LH (group II hormones).

Text book:

1. Lehninger, AL, Nelson DL and Cox MM, Principles of Biochemistry
2. Dr.U. Satyanarayana, Biochemistry, 2nd edition, Uppala Author Publishers Interlinks(2003)

References:

1. Lubert Stryer, *Biochemistry*, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, *Biochemistry*, 2nd Edition, John Wiley & Sons Inc., 1995.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., *Harper's Biochemistry*, Prentice Hall International.

BT233 GENE AND GENE EXPRESSION

Credits: 4:0:0

Unit I Structure Of Nucleic Acid

Structure of DNA, different forms of DNA and RNA, Identification of DNA as genetic material-Griffith, Avery, McLeod and McCarty, Frankel and Singer, Hershey and Chase, Meselson and Stahl experiment.

Unit II Replication Of Nucleic Acids

Semi conservative replication, different models of replication in prokaryotes, replication of DNA in Eukaryotes, Telomeric DNA replication

Unit III Expression - Transcription And Translation

Synthesis and processing of different forms of RNA, their importance-Genetic code-Transcription-Eukaryotes & Prokaryotes, post transcriptional modification; Translation in Prokaryotes and Eukaryotes; Post translational modification-targeting and localisation of protein (endoplasmic reticulum lumen protein).

Unit IV Splicing And Mutation

RNA splicing-retroposons; Molecular basis of mutation; different types of mutation; UV repair mechanisms.

Unit V Gene Regulation

Gene regulation-operon concept-gal, lac, trp

Text Books

1. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.

2. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut. S.Ignacimuthu.S.J. (2004). Plant Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd.

Reference Books

1. Watson, "Molecular Biology of gene"
2. David Freifelder, "Essential of Molecular Biology"
3. Molecular Biology" by Weaver.
4. T.A.Brown, "Genetics – A molecular approach"

BT234 INTRODUCTORY MICROBIAL BIOTECHNOLOGY

Credits: 4:0:0

Unit – I: Introduction to Microbiology

Basic of microbial existence: history of microbiology, classification and nomenclature of microorganism. Structural organization and multiplication of bacteria, viruses, algae and fungi. Nutrient requirements of bacteria and different media used for bacterial culture, bacterial growth curve, aerobic and anaerobic bacteria, Preservation and maintenance of microbes.

Unit – II: Microbes in pharmaceutical, food industries and Agriculture

Production, harvest, recover/uses and mode of action – enzymes, antibiotics, vitamins (B12), organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), amino acids, beverages (beer, wine), single cell protein (SCP), biofertilizer, biopesticide.

Unit – III: Bioremediation

Xenobiotics-microbial mechanism, microbial mining, ore leaching, oil recovery, Bioreactors for waste water treatment-Activated sludge process, Biological filters, Rotating biological contactors (RBC), Fluidized bed reactors (FBR), Contact digesters, Packed column reactors, membrane bioreactors, Use of immobilized enzymes and microbial cells.

Unit – IV: Biotechnology for solid waste management

Solid waste treatment - Composting, Vermicomposting, animal feed, mushroom cultivation, oil spill remediation, biomedical waste treatment.

Unit-V: Biomass energy

Energy sources – A general account, useful features of biofuel, biomass- definition and modes for utilization of biomass, biogas production, bioethanol and biodiesel.

Text Books:

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India; 2001.
2. Wolf Cruger and Anneliese Cruger, (2003) Biotechnology: A text book of industrial microbiology, Panima publishing corporation.
3. Jogdand SN, Environmental Biotechnology, Himalaya publishing house, Bombay (1995).

References:

1. Dubey RC, 1995. Text book of Biotechnolog, S. Chand and Co.
2. Treven, MD, 1993. Biotechnology, The Biotechnology principles. Tata McGraw Hill Edition, New Delhi, India.
3. Arumugam, Biotechnology, Saras publication.
4. Patel, AH, Industrial microbiology. Himalaya publishing house, New Delhi

BT235 APPLIED BIOTECHNOLOGY

Credits: 4:0:0

Unit I: Cells, Tissue, and Organs
Introduction to the basic principles of cell structure, the organization of cells into tissues and organs, and the principles of organ systems.

Unit II: Cell and Molecular Biology
Introduction to the basic principles of biochemistry and molecular biology, DNA, genetic code, gene regulation.

Unit III: Genetics and Genetic engineering
Principles of Mendelian inheritance and chromosomal basis of heredity, Lamarckism Lysenrko. Prokaryotic gene expression, Eukaryotic gene expression, Microbial genetics, Transgenics, GMOs, Stem cells and applications, gene therapy.

Unit IV: Plant Biology
Biotechnology definition, history and scope, Isolation and cultivation of economically important microbes. Tissue culture- media, Micropropogation, callus formation and protoplast fusion, Single cell protein,. Biofertilizers- Production of primary and secondary metabolites, Vernalisation – Photo periodism.

Unit V: Human biology
Nervous system, brain, parts of brain and their functions; circulatory system, heart and its function. Overview of Immune system – Innate and acquired immunity- humoral and cell mediated immunity-active, passive and adaptive immunity. Organs and cells involved in immune responses-primary and secondary lymphoid organs.

Text book:

1. Gupta P.K. 2004. Elements of Biotechnology. Rastogi Publications, Meerut.
2. Dubey, R.C. 2004. Text Book of Biotechnology. S. Chand & Co.

Reference Books:

1. T.A Brown , Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002.
2. Kuby, J., 1994, Immunology. W.H. Freeman and Company, New York

BT236 MASS TRANSFER OPERATIONS.

Credits: 4:0:0

Unit-I Diffusion in fluids.

Molecular and Eddy diffusion in a gas and liquid , Steady state diffusion under stagnant and laminar flow condition. Diffusion measurement and calculations. Ordinary diffusion in multicomponents gaseous mixtures, diffusion in solids. Interface mass transfer , Theory of mass transfer , Concept of mass transfer coefficient, overall mass transfer coefficient , Analgies between momentum and mass transfer coefficients.

Unit-II Distillation.

Vapour – Liquid equilibrium diagram, Raoults law derivations from ideality , methods of distillation – Batch and continuous distillation. Types of distillation – Simple distillation , flash distillation, Fractional distillation. Design calculations of by McCabe –Thiele method and Ponchon Savarite methods. Various industrial distillation – Extractive distillation , molecular distillation, Azeotropic distillation, steam distillation.

Unit –III Absorption.

Theories of gas absorption, Desgn of absorption towers , absorption with chemical reaction, Types of packing and Characteristics , Concept of NTU and HTU.

Unit – IV Adsorption Ion-Exchange.

Theories of adsorption of gases and liquids : industrial adsorbents. Adsorption equipments for batch and continuous operation. Principles of Ion –Exchange,
Industrial equipments .

Unit – V Leaching and Extraction:

Solid – liquid equilibrium, Leaching equipment- Batch and continuous types: Calculations of number of stages.Equlibrium in ternary systems , batch and continuous extractors. different contact Extractors.

Text book;

Unit operation of Chemical Engineering – Chattophathya – Khanna publication

Reference books:

1. R.E Treybal, " Mass Transfer Operations" McGraw Hill
2. W.L McCabe Smith and Harriot P " Unit Operations of Chemical Engineering" Sixth edition McGraw Hill , International edition, 2001.
3. C.Judson King "Separation Proc**ess**

BT237 PROTEIN ENGINEERING

Credits: 4:0:0

Unit I Bonds and Energies in Protein Makeup

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein

structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

Unit II Amino Acids and Their Characteristics
Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

Unit III Protein Architecture
Primary structure, Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, Tertiary structure: Domains, folding, denaturation and renaturation, Quaternary structure: Modular nature, formation of complexes.

Unit IV Structure-Function Relationship
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes : Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase

Unit V Methods of Protein Engineering
Methods of Proteins engineering, Immunotoxins, Drug Designing

Text Books
Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999

References
Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
Moody P.C.E. and Wilkinson A.J. "Protein Engi

BT238 ENZYME ENGINEERING AND TECHNOLOGY

Credits: 4:0:0

Unit I Introduction and Application of Enzymes
Classification of enzyme; Types of enzymes-Constitutive enzyme, induced enzymes, Intracellular and Extracellular enzymes; Application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications.

Unit II Mechanisms and Kinetics of Enzyme Action
Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action , kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multi substrate reactions- mechanisms and

kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.

Unit III Purification and Characterization
Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

Unit IV Enzyme Immobilization
Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme system

Unit – V Enzyme Biosensors
Types of Biosensors; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

Text Books

1. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker, Inc.
2. James M. Lee, "Biochemical Engineering", PHI, USA.

References

1. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.
2. Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub

BT239 BIOPROCESS ENGINEERING

Credits: 4:0:0

Unit I Design and Analysis of Bioreactors
Design and operation of novel bioreactors-Air-lift loop reactors; Fluidized bed-bioreactors; packed bed reactor, Bubble column reactor, RTD and stability analysis of bioreactors

Unit II Bioreactor Scale-Up
Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed

Unit III Monitoring of Bioprocesses
On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry ; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes;

Unit IV Modern Biotechnological Processes

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures

Unit V Modelling and Simulation of Bioprocesses

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

Text Books

1. Anton Moser, "Bioprocess Technology", Kinetics and Reactors", Springer Verlag.
1. James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.

References

1. James M. Lee, "Biochemical Engineering", PHI, USA.
2. Atkinson, "Handbook of Bioreactors",
3. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Decker Inc.

BT240 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credits: 4:0:0

Unit I: Outlines of Immunology

Historical perspectives and overview of Immune system – Innate and acquired immunity-humoral and cell mediated immunity-active, passive and adaptive immunity – idiotypic network. Organs and cells involved in immune responses – organs of stem cell origin, primary and secondary lymphoid organs – Hemopoietic stem cells, T cells, B cells, Macrophages, Monocytes, Polymorphs and Platelets – Immunological memory – Differentiation of lymphocytes.

Unit II: Antigens, Antibodies and Complements

Antigens and antigenicity :Types, structure and requirements for immunogenecity – Antibody specificity – Antigen specific receptor of antibodies – Regional variation of antigen binding site.

***Immunoglobulins*:** structure, function and biological properties of Ig classes – organization and expression of immunoglobulin genes – Generation of antibody diversity – Gene segment codes for each L and H chain.

Interactions of antigen and antibody: Primary interaction – secondary phenomena-precipitation, agglutination, opsonisation and cytolysis. Complement and its activation, biological role of complement components – Sequential proteolytic cascade – complement activation – classical and alternate pathways.

Unit III: Immune Response

***Humoral immune response*:**

Antibody synthesis – clonal selection – model kinetics of primary and secondary responses – Cellular Cooperation – B cell activation for T independent and dependent antigens – isotype switching.

***Cell mediated immune response* :**

Phagocytosis – role of T cells, macrophages and NK cells. Subtypes of Tcells and their functions: Cytotoxic T cells, Helper T cells, Suppressor T Cells and Regulatory T cells – cell mediated cytotoxicity – Lymphokines and Cytokines – their biological role.

Unit IV. Immunopathology and Immunologic disorders

***Hypersensitivity* :**Types, mechanism and disorders of hypersensitivity.

***Autoimmunity*:**Spectrum of autoimmune diseases – Immunodeficiency states – Autoantibodies in human dise– Aetiology of autoimmune responses – HLA system and disease association – MHC and its significance – class I and class II antigens of MHC. Immunologic disorders, immunoprophylaxis and immunotherapy – immunodeficiency diseases – Transplantation and rejection – Tumor antigens and immune responses to tumours – Natural and artificial immunotherapy.

Unit V. Immunity to infections and Immunotechnology

Immunity to viruses, bacteria, fungi and parasites – Immunity to infectious diseases: leprosy, tuberculosis, malaria, amoebiasis, rabies, typhoid, hepatitis, AIDS. Active immunization – Passive immunization – Polyclonal antibody production – Hybridoma techniques in monoclonal antibody production and their applications. Principles and methods of vaccine preparation – Edible vaccines. Immunological techniques: RIA, ELISA, Immunocytochemistry, Immunoblotting , Flurescence antibody techniques.

Reference Books:

(1) Ivan Roitt ,1994, Essential Immunology, 8th Edn., Blackwell ScientificPublication.
(2) Ivan Roitt, Jonathan Brostoff, David Male (Eds.)., 1993, Immunology, 3rd Edn.,Mosby Publication.
(3) Weir, D.M. and Stewart, J.,1997, Immunology, 8th Edn. Churchill Livingston,New York.
(4) Eryl Liddell and Ian Weeks.,1995, Antibody Technology, BIOS ScientificPublishers.
(5) Abul K. Abbas, Andrew K. Lichtman & Jordan S. Pober (Eds.), 1997 , Cellularand Molecular Immunology, 3rd Edn. W.B.Saunders Company.
(6) Bruce Alberts,, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D Watson (Eds.) ,1994, Molecular Biology of the Cell, 3rd Edn., Garland Publishing Inc.., New York.
(7) Kuby, J., 1994, Immunology. W.H. Freeman and Company, New York.

BT318 ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

Credits: 4:0:0

Unit I: **Environmental pollution and social Issues**

Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal. Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.

Unit II: **Industrial Waste Water Management**

Purification of waste water; Aerobic and anaerobic treatments; Laboratory methods for the detection of coli form organisms in water; Water recycling methods; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.

Unit III: **Biomass, Energy and Solid waste Management**

Biomass waste as renewable source of energy; Cellulose and Hemi cellulose as source of energy; Methods of energy production; Conversion of Solid Waste to Methane; Biogas production; Biofuels and Microbial fuel cells; Management of Sludge and Solid waste treatment- Land filling, lagooning, Composting and Vermi Composting,Ecofriendly agriculture.

Unit IV: **Biodiversity and Conservation**

Definition, Types, Genetic, Species, Ecosystem; Biodiversity at Global Levels; Values of Biodiversity; Hotspots in Biodiversity; Loss of Biodiversity and its causes threats to Biodiversity; Biodiversity and its Conservation- In situ and Ex situ, IPR and Patenting, Patenting of Higher Plants, Animal Genes and DNA Sequences; Plant Breeders Right and Farmers Right.

Unit V: Bioremediation and Biodegradation

Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation; Bioremediation of Ground Water; Biodegradation of Hydrocarbons, Pesticides, Herbicides, Insecticides and Xenobiotics.

Text and Reference Books:

1. Indu shekhar Thakur, 2006. Environmental Biotechnology- Basic concepts and Applications.
2. Foster C.F; Johnware D.A, 1987. Environmental Biotechnlogy.Ellis Harwood Ltd.
3. Chakraborty K.D. Omen G.S. Biotechnology and Bio degradation, Advances in Applied Biotechnology series, Vol. 1, Gulf Publications Co. London 1989.
4. Organic farming BY Dr.Sharma

References

1. Stanier R.Y. Ingraham J.L. Wheels M.L. Painter R.R. General Microbiology, McMillan Publications, 1989.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., Mc Graw Hill, 1986.
3. Alam Scragg, Environmental Biotechnology, Publication & Distributors Harlow, Engg. Longman, 1999.

BT 319 ADVANCED PLANT AND ANIMAL BIOTECHNOLOGY

Credit :3:1:0

Unit I: Introduction

Plant and Animal Biotechnology - product safety, public perception of Biotechnology – Legislation, Regulatory and safety aspects of GMOs, GMFs. Transgenics – Ethical concerns and solutions - Importance in Bio protection and conservation

Unit II: Plant cell and tissue culture

Techniques involved - Protoplast isolation, culture and fusion, Properties and applications of Hairy root cultures – Bioreactors for Plant cell and Tissue cultures - Plant cell cultures for the production of food-related chemicals: pigments perfumes, flavors

Unit III: Genetic Engineering

Techniques for the insertion of foreign genes into plant cells, Ti plasmid and vectors, production of transgenic plants, (i) Transgenic plants (ii) gene cloning, restriction fragment length polymorphisms, transposons, and insertional mutagenesis – Transgenic plants as sources of modified oils

Unit IV: Basic techniques of animal cell culture and their application

Introduction of novel genes – Transfection, Retrovirus vectors, nuclear transfer for mammalian cells, transgenic animals, in vitro fertilization and embryo transfer, molecular biological techniques for rapid diagnosis of genetic diseases

Unit V: Applications of animal biotechnology

Production of biopharmaceuticals, xenotransplantation, Gene therapy – Basics and application to cancers and Tumours – Therapeutic applications of antisense nucleic acids

Text Books:

1. P.K.Gupta., Introduction to Biotechnology.Rostogi Publication
2. Genome Organization and Expression in Plants: C.J. Lever, plenum press Plant Molecular biology: D. Grierson & S.N. Covey Blackie, London.
3. Plant Tissue Culture: Applications and Limitations. S.S. Bhojwani (1990), Elsevier, Amsterdam.
4. Plant biotechnology In Agriculture: K. Lindsey and M.G.K. Jones (1990), Prentice hall, New Jersey.
5. R.E. Spier and J.B Griffiths. Animal cell Biotechnology, Academic Press. (1998)
6. Johnson A. and Holland A Animal Biotechnology and Ethics , Chapman and Hall, Madras, 1998.
7. Hui, K.M. Gene therapy – From Laboratory to the Clinic, World Scientific Publishing Co. Pvt. Ltd. Singapore, 1994.
8. Dashek W.V. Methods in Plant Biochemistry and Molecular Biology, CRC Press, 1997.
9. Kirsi-Marja Oksman-Caldentey and Barz W.H. Plant Biotechnology and Transgenic Plants**,** Marcel Dekker Inc., 2002.

10. Living resources for Biotechnology, Animal cells ; a.Doyle, R.Hay and B.E. Kirsop (1990), Cambridge University Press, Cambridge.

BT320 ANATOMY AND PHYSIOLOGY

Credit :4:0:0

Unit I: Basics:
Basic Embryology, Ostelogy and Histopathology, Circuitatory and Respiratory Systems: Structure of heart, structure of lungs, Traches and its branchings, General circulation, Capillary circulation, Venous return, Neural control of cardio vascular system, Regulation of breathing, Carrier of oxygen and carbon dioxide, Dyspnoea , Blood, neurosis, multinuclear nature, multi vacuolar nature.

Unit II: Nervous and Sensory Systems:
Structure and function of nervous tissues, Reflex action, Afferent nervous systems, Regulation of posture, Physiology of emotion, Regulation of temperature, Cerebro spinal fluid , sensory end organs, Tongue, Mechanism of sight, hearing and smelling.

Unit III: Digestive System:
Structure of alimentary canal, Related digestive glands, Mechanism of alimentary canal, Secretion of digestive fluids, Liver, Function of liver.

Unit IV: Excretory Systems:
Structure of Kidney, Bladder and Colon, Physiology of Perspiration, Physiology of urine formation, Physiology of miaturation, Physiology of defecations.

Unit V: Endocrine System:
Pituitary gland, Thyroid and Parathyroid glands, pancreas, Ovary and Testis.

References:
1. Charles A.Jacob, “Textbook of Anatomy and Physiology in Radiological Technology”, The C.V.Mosby Company, Sam Louis, 1968.
2. Warrik C.K, “Anatomy and Physiology for Radiographers”, Oxford University press, Henglong, 1977.
3. Syril A Kalee and Eric Neil, Samsons Wright, “Applied Physiology”, Oxford University Press, Hongkong, 1979.

BT321 BIO CHEMISTRY AND HUMAN PHYSIOLOGY LAB

Credit: 0:0:2

1. Recording of Muscle Response to Induced Electrical Stimulation
2. Study of rate of Conduction of Nerve Impulses.
3. Isolated Frog Heart Perfusion and Effect of ionic Changes.
4. Testing of Hearing using Tuning Fork.
5. Testing of various parameters of Vision and Errors of Refraction.
6. Testing for Detection of Glucose, Fructose and Starch.

7. General Test for Proteins
8. Testing of Urine for presence of Sugar, Protein

Estimation using Spectrophotometer

BT322 PATHOLOGY AND MICRO BIOLOGY

Credit: 4:0:0

Unit I Normal Cell Structure

Cell Degeneration and regeneration - Inflammations, apoptosis, Neoplasia. Classification, Difference between benign and malignant tumors – Etiology of tumors – Spread of Tumors.

Unit II Fluid Aod Heamodynamic Derangement

Edema,l Shock, Hemorrhage – Thrombus – Embolism – Disseminated intra vascular Coagulation – Hematological disorders. Bleeding Disorders – Leukemia – lymphoma.

Unit III Genetic Disorders, Infection and Immunity

Autosomal and Sex linked disorders – Storage disorders – Types of hypersensitivity reactions – Immune deficiency Syndrome – Primary – HIV – Viral disease. Chlamydial – Bacterial – mycoplasma – Rickettsial disease – Fungal, protozolal. – Helminthic disease.

Unit IV General Structural Organization of Bacterial, Viral Cell

Growth and Identification of Bacteria, Observation of culture.

Unit V Microscopy

Light Microscopy – Dark field Microscopy – Phase contrast microscopy – electron microscopy. Identification of disease producing organism, Simple Stain, Gram Stain, AFB Stain, Fluorescent techniques, Antigen – Antibody Technique.

Text book:

1. Robbins S.L & Ramzi S.C, “Pathologic Basis of Diseases’, W.B. Saunders Co. 1999
2. Anatha Narayanan.R & Jayaram Panicker C.R, ‘Text Book of Microbiology, Orient Laongman’1998.

BT323 HOSPITAL MANAGEMENT

Credit: 4:0:0

Unit I Need and Scopes Of Clinical Engineering

Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital

Unit II National Health Policies

Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation

Unit III Training and Management Of Technical Staff In Hospital

Difference between hospital and industrial organization, levels of training, steps of training, developing training program, evaluation of training, wages and salary, employee appraisal method.

Unit IV Standards and Codes In Health Care
Necessity for standardization, FDA, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.

Unit V Computer in Medicine
Computer application in ICU, X-Ray department, laboratory administration, patient data, medical records, communication, simulation.

Text Books

1. Webster J.C. and Albert M.Cook, "Clinical Engineering Principle and Practice", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979 (Unit I).
2. Goyal R.C., "Handbook of hospital personal management", Prentice Hall of India, 1996 (Unit II – V).

BT324 RADIOLOGICAL EQUIPMENTS

Credit: 4:0:0

Unit I X-Rays
Principles and production of soft and hard X-rays, selection of anodes, Heel Pattern. Scattered radiation, Porter Bucky system, Cooling system.

Unit II Radio Diagnosis:
Radiography, Angiography, Fluoroscopy, Image Intensifier, Multi section radiography.

Unit III Special Radiological Equipments
Principle, Plane of Movement, Multi section Radiography, CAT. Principle of NMR, MRI

Unit IV Application Of Radioisotopes
Alpha, Beta and Gamma emission, Principle of radiation detectors, dot scanners, nuclear angiogram, Principles of Radiation therapy.

Unit V Radiation Safety
Hazardous effect of Radiation, Radiation protection Techniques, Safety Limits, Radiation Monitoring.

References:

1. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.
2. Steve Webb, "The Physics of Medical Imaging ", Adam Hilger Philadelphia 1988.
3. William R.Hendee, E.Russel Ritenour," Medical Imaging Physics", Third Edition, Mosby Year Book, St. Louis, 1992.

BT325 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

Credit: 4:0:0

Unit I Cardiac System

ECG, sources of ECG, normal and abnormal waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types.

Unit II Neurological System

EEG, genesis, lead system, wave characteristics, frequency bands, spontaneous and evoked response, diagnostic interpretation, epileptic discharges.

Unit III Ultrasonic Techniques For Diagnosis And Safety Measures

Basic principles of Echo technique, display techniques A, B, M modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynaecology. Patient Safety: Sources of leakage current, Micro and Macro shock, monitoring circuits, earthing schemes.

Unit IV Heart-Lung Machine

Need for the unit, functioning of bubble, disc type and membrane type oxygenerators, fingerpump, roller pump, electronic monitoring of functional parameter.

Unit V Respiratory Measurement and Ventilator

Spirometer, Respiratory volume measurement, pnemograph, artificial respirator – IPR type, functioning.

References:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, NewDelhi, 1997.
3. Joseph J.carr and John M. Brown, "Introduction to Biomedical equipment technology", John wiley and sons, New York, 1997.

BT326 COMPUTERS IN MEDICINE

Credit: 4:0:0

Unit I Overview of Computer Hardware Pc-At

8086 architecture, system connections, Instruction set & programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

Unit II System Design

Multichannel computerised ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

Unit III Computers in Patient Monitoring
Physiological monitoring, automated ICU, computerised arrhythmia monitoring, information flow in a clinical lab, computerised concepts, interfacing to HIS.

Unit IV Computers in Medical Systems Modeling
Radiotherapy, drug design, drug delivery system, physiological system modelling and simulation.

Unit V Computers in Medical Research
Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts.

Text Books

5. R.D.Lele, "Computers in Medicine", Tata McGraw-Hill, New Delhi, 1999.
6. Douglas V.Hall, "Microprocessors and Interfacing : Programming and hardware", McGraw Hill, Singapore, 1999.

BT327 PATHOLOGY AND MICROBIOLOGY LAB

Credit: 0:0:2

12 experiments will be notified by HOD from time to time

BT328 MEDICAL PHYSICS

Credit: 4:0:0

Unit I Atomic Physics .
Traditional definition of atom, periodic system of elements, mechanical properties of atom, emission of light and its frequencies. Electromagnetic spectra. **Principles of Nuclear Physics** – Natural radioactivity, Decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Radionuclides used in Medicine and technology.

Unit II Interaction with Living Cells
Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, depression of Macro molecular synthesis, Chromosomal damage.

Unit III Somatic Effect of Radiation
Radio sensitivity protocol of different tissues in human, LD 50/30 effect of radiation on skin, blood forming organs, lenses of eye, embryo and Endocrinal glands.

Unit IV Genetic Effect of Radiation
Threshold of linear dose effect, relationship, factors affecting frequency of radiation induced mutation, Gene controlled hereditary diseases, biological effect of microwave and RF wave.

Variation in dielectric constant and specific conductivity of tissues. Penetration and propagation of signals effects in various vital organs, Protection standards.

Unit V Photo Medicine

Synthesis of Vitamin D in early and late cutaneous effects, Phototherapy, Photo hemotherapy, exposure level, hazards and maximum permissible exposures.**LASER PHYSICS –** Characteristics of Laser radiation, Laser speckle, biological effects, laser safety management.

References:

1. Moselly, 'Non ionising Radiation' Adam Hilgar Brustol 1988
2. Branski.S and Cherski.P 'Biological effects of Microwave' Hutchinson & ROSS Inc. Strondsburg 1980.
3. Glasser.O.Medical Physics Vol.1, 2, 3 year Book Publisher Inc Chicago, 1980.

BT329 BIOMATERIALS & ARTIFICIAL ORGANS

Credit: 4:0:0

Unit I Structure of Bio-Materials and Bio-Compatibility

Definition and classification of bio-materials, mechanical properties, visco elasticity, wound-healing process, body response to implants, blood compatibility.

Unit II Implant Materials

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons, medical applications.

Unit II I Polymeric Implant Materials

Polymerisation, polyolefin, polyamicles , Acryrilic, polymers, rubbers, high strength thermoplastics, medical applications.

Unit IV Tissue Replacement Implants

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

Unit V Artificial Organs

Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants

References:

PARK J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.

BT330 BIO REACTOR DESIGN

Credit: 4:0:0

Unit I Introduction
Introduction, types of bioreactors: stirred-tank bioreactors, airlift bioreactors. Heat transfer. Scale up: stirred-tank bioreactors, airlift bioreactors.Introduction of airlift bioreactors, design and construction of the airlift-loop reactor, hydrodynamics, three-phase flow, mixing, oxygen transfer: isobaric method, non-isobaric model, oxygen transfer in a three-phase flow.

Unit II Bioreactor Instrumentation and Control
Introduction, bioreactor sensor characteristics, temperature measurement and control, principles of dissolved oxygen measurement and control, principles of pH/redox measurement and control, detection and prevention of foam, determination of biomass, ion specific electrodes, biosensors

Unit III Methods and Strategies for Fermentation Control
Introduction to control: control loop, analogue and digital control, control algorithm-PID control, time-proportional control. Physical control of fermentation: temperature, airflow, pressure, agitation, pH control, dissolved oxygen, fermenter content, feeding, vent gas analysis. Control strategy for fermentation: estimation of biomass, handling noisy measurements, biological control-feedback and feed forward, adaptive control and adaptive models, fault diagnosis.

Unit IV Modeling and Simulation of Fermentation Processes
Modeling, digital simulation, formulation and solution of problems by simulations, numerical solution, digital simulation programming languages, ISIM (interactive simulation language).

Unit V Plant and Animal Cell Bioreactors
Introduction, plant cells: plant cell bioreactors, characteristics of plant cell suspensions, plant cell bioreactor requirements, plant cell bioreactor design, plant cell bioreactor operation, alternative cultures for plant cells. Animal cells: Animal cell bioreactors, animal cell bioreactor operation, animal cell bioreactor design.

Text Books
Scragg A.H., “Bioreactors in Biotechnology”, Edited by, Ellis Horwood Limited, England 1991

Reference Books
Mukhopadhyay S.N., “Process Biotechnology Fundamentals”, 2nd edition, Viva Books Private Limited, Chennai 2004.

BT331 ADVANCED CHEMICAL REACTION ENGINEERING

Credit: 4:0:0

Unit I Basics of Reactor Design

Rate of a order and molecularity of a reaction, elementary and non elementary of a reaction, Rate law, Concentration and temperature dependent term of a rate equation, interpretation of rate data in variable and constant volume systems.

Unit II Ideal Reactors

Design of batch, tubular and stirred tank reactors, space-time and mean-resistance time

Unit III Multiple Reactions

Qualitative and Quantitative treatment of Series, Parallel and Series-Parallel reactions. Instantaneous and overall fractional yields

Unit IV Non-Ideal Flow

Residence time distribution: Residence time functions and relations among them, application to non – ideal reactors. Dispersion and tanks–in-series models.

Unit V Solid Catalysts

Principles of preparation, properties estimation, catalyst promoters, catalyst poison, important industrial catalyst reactions.

Text Books

1. Octave Levenspiel, "Chemical Reaction Engineering",3rd Edn., John Wiley & Sons, Singapore, 1999.
2. Scott Fogler H., " Elements of Chemical Reaction Engineering",2nd Edn.,Prentice Hall of India, New Delhi,1995.

Reference Books

1. Smith J.M., "Chemical Engineering Kinetics",3rd Edn.,McGraw Hill International Editions, New Delhi,1981.
2. Ronald.W.Missen,Charles.A.Mions,Bradley.A.Saville, " Introduction to Chemical Reaction Operation and Kinetics", John Wiley and Sons, Singapore, 1999.

BT332 MOLECULAR BIOLOGY & GENETIC ENGINEERING

Credit: 4:0:0

Unit I Structure of Nucleic Acid & Replication

Structure of DNA, different forms of DNA and RNA, Identification of DNA as genetic material-Griffith, Avery, McLeod and McCarty, Frankel and Singer, Hershey and Chase, Meselson and Stahl experiment

Semi conservative replication, different models of replication in prokaryotes, replication of DNA in Eukaryotes, Telomeric DNA replication

Unit II Transcription, Translation and Gene Regulation

Synthesis and processing of different forms of RNA, their importance-Genetic code-Transcription-Eukaryotes & Prokaryotes, post transcriptional modification; Translation in Prokaryotes and Eukaryotes; Post translational modification-targeting and localisation of protein (endoplasmic reticulum lumen protein, RNA splicing-retroposons; Molecular basis

of mutation; different types of mutation; UV repair mechanisms, Gene regulation-operon concept-*gal, lac, trp*

Unit III Basic Tools in Genetic Engineering

Restriction enzymes-Classification-nomenclature; Ligases-Modifying enzymes; Probe preparation-Radioactive labels-nonradioactive labels-Different labeling methods; Southern hybridization-Northern hybridization; Autoradiography; PCR-different kinds-Application; DNA sequencing; DNA finger printing-RFLP Analysis-chromosome walking.

Unit IV Cloning Strategy & Vectors of Prokaryotes

Plasmid biology-Plasmids as vectors- PBR322- Derivatives of pBR 322- pUC vectors-Other artifical plasmids-Phage-Lifecycle-M13-Lambda phages-Invitro packaging-Cosmids-Phasmids-Cloning vectors in Gram positive bacteria- Cloning vectors in streptomycetes, Construction of recombinant DNA: Preparation of competent cell-Transformation, transfection-Recombinant selection and sereening; Genomic DNA library; cDNA synthesis strategies -Linkers-Adapters-Homopolymer tailing; cDNA library-

Unit V Expression Vectors & Gene Modification & Application of Recombinant Dna Technology

Eukaryotic cloning vectors-Prokaryotic expression system-Eukaryotic expression vectors-Yeast expression system-Retroviral vectors-Bacullovirus, Mammlian cells-SV40; Gene transfer techniques,

Mutagenesis-Deletion mutagenesis, Oligonucletoide derived mutagenesis, Site directed mutagensis-Its applications; Applications of rDNA technology in Diagnistics; Pathogensis; Genetic diversity; Therapeutic proteins-Vaccines

Text Books

1. T.A.Brown, “Genetics – A molecular approach”
2. Gene Cloning by T.A.Brown
3. Old R.W.Primrose SB, “Principles of Gene Manipulation, An Introduction to Genetic Engineering- Backwell Scientific Publications

Reference Books

1. Watson, “Molecular Biology of gene”
2. 2. David Freifelder, “Essential of Molecular Biology”
3. “Molecular Biology” by Weaver.
4. From Genes to Clones by Winnacker

BT333 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credit : 0:0:2

12 experiments will be notified by HOD from time to time

BT334 DOWN STREAM PROCESSING IN BIOTECHNOLOGY

Credit: 4:0:0

Unit I Role of Downstream Processing in Biotechnology

Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products), physico-chemical basis of bioseparation processes

Unit II Primary Separation and Recovery Processes

Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods

Unit III Enrichment Operations

Membrane based separations micro and ultra filtration theory, design and configuration of membrane separation equipment, applications, precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction) insitu product removal, integrated bioprocesing

Unit IV Product Resolution/Fractionation

Adsorptive chromatographic separation processes, electrophoretic separations (all electrophoresis techniques including capillary electrophoresis) hybrid separation technologies (membrane chromatography, electro chromatography etc)

Unit V Product Polishing

Gel Permeation Chromatography, dialysis, Crystallisation

Text Books

1. "Product Recovery in Bioprocess Technology", BIOTOL Series, VCH, 1990
2. Asenjo J.M., " Separation processes in Biotechnology " Marcel Dekker Inc. 1993.

Reference Books

1. Wankat P.C, " Rate controlled separations ", Elsevier, 1990.
2. Belter PA and Cussler E, " Bioseparations ", Wiley 1985

SCHOOL OF BIOTECHNOLOGY

ADDITIONAL SUBJECTS

Code	Subject Name	Credits
BC213	Food Biochemistry and Nutrition	3:0:0
BC214	Analytical Biochemistry Lab	0:0:2
BC215	Engineering Biochemistry	3:0:0

BC213 FOOD BIOCHEMISTRY AND NUTRITION

Credit : 3:0:0

To enable the students to understand

1. Basics of biochemistry and nutrition
2. Importance of nutrition
3. Nutrients in their food and their importance.

Unit I Electron Transport Chain,Glycolysis
Embden Meyerhof Pathway (EMP), gluconeogenesis,glycogenolysis,TCA cycle, Pentose phosphate shunt, gluconeogenesis, urea cycle- bioenergetics, energy rich compounds,oxidative phosphorylation.

Unit II Biosyntheses and degradation of fatty acids, and cholesterol
Biosyntheses and degradation of essential amino acids namely arginine, valine,histidine,isoleucine,leucine,lysine,methonine,phenylalanine,threonine and tryptophan, peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids.

Unit III Basic concept of nutrition
– Importance of nutrition and dietetics, Nutritional labeling and its importance, Nutrient supplementation, fortification
Carbohydrates-classification, source, energy value of carbohydrates, determination of energy value, dietary fibre, Inborn errors of Carbohydrate metabolism - Lactose intolerance **,** metabolism -balanced diet ,Recommended dietary intake , Acceptable dietary intake –
Proteins-classification, essential amino acids, source, metabolism, Protein efficiency ratio, Net protein utilisation and their determinations , Malnutrition and its problems, antinutritional factors.

Unit IV
Fats- classification, metabolism of fat ,Inborn errors of and fat metabolisms – **Minerals**-Classification, source-,,metabolism- **Vitamins**-classification, source, metabolism-**water**-importance, functions, water balance.

UnitV Nutrition for specialized purposes

Paediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods-**Ageing** –Theories of ageing – Nutrition and ageing – Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, Alzheimer's disease

Text / Reference Books:

1. Lehninger A.L, Nelson D.L., M.M. Cox, *Principles of Biochemistry*, CBS Publications, 1993.
2. Voet D, Voet G, Biochemistry, Second Edition, John Wiley and Sons, 1994.
3. Stryer L, Biochemistry, Fouth edition, 1994.
4. Food and Nutrition, Wahlquist M L, 1997
5. Principles of Human Nutrition – Second Edition, Edited by Martin Eastwood, Blackwell Publishing
6. Functional foods and Nutraceuticals in Cancer Prevention, Edited by Ronald Ross Watson

BC214 ANALYTICAL BIOCHEMISTRY LAB

Credit : 0:0:2

12 experiments will be notified by HOD from time to time

BC215 ENGINEERING BIOCHEMISTRY

Credit : 3:0:0

Unit - I : Structure and Properties of Carbohydrates and Lipids

Structure and properties of mono, di, oligo and polysaccharides, Structure and of fatty acids, phospholipids, sphingolipids, glycolipids and steroids.

Unit – II : Structure and Properties of Proteins and Nucleic Acids

Structure and properties of amino acids, peptides, proteins. Structure and properties of purines, pyrimidines, polynucleotides - rRNA, mRNA and tRNA, deoxy ribonucleic acids

Unit – III : Intermediary Metabolism and Bioenergetics

Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle. Carbohydrate Metabolism: Glycolysis, pentose phosphate pathway, TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis.

Unit – IV : Metabolism of Lipids, Proteins and Nucleic Acids

Lipid Metabolism: Biosynthesis and biodegradation of fatty acids.Biodegradation of proteins and nucleic acids. Biosynthesis and biodegradation of important amino acids- Leu, Tyr, Phe, Trp, and Cys- Urea Cycle, purines and pyrimidines, Inborn errors of their metabolism.

Unit-V : Mechanism of enzyme action

Enzyme – Introduction, substrate specificity, Coenzymes, Rate of enzymatic reactions-chemical kinetics, inhibition, effect of pH, bisubstrate reactions, Michaelis menton equation.

Text book:

Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.

References:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., (2000). Harper's Biochemistry, Prentice Hall International.

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ADDITIONAL SUBJECTS

Code	Subject Name	Credits
MB209	Food Microbiology	3:0:0
MB210	Fundamentals of Biological Systems	3:0:0
MB211	Community Health and Social Awareness	3:0:0
MB212	Cell Biology and Microbiology Lab	0:0:1
MB213	Molecular Biology and Genetic Engineering Lab	0:0:1
MB214	Cell Biology and Microbiology Lab	0:0:1
MB215	Molecular Biology and Genetic Engineering Lab	0:0:2
MB306	Molecular Biology And Genetic Engineering Lab	0:0:2

MB209 FOOD MICROBIOLOGY

Credit : 3:0:0

Unit I

Micro organisms associated with foods: Bacteria – Gram negative aerobic Rods, Gram negative facultative anaerobic Rods- Gram Negative anaerobic rods - Endospore formers Irregular non-sporing gram positive rods their role in food spoilage Molds, Definitions - Fungi as Food, importance of molds, Molds in the category of Zygomycetes, Deuteromycetes etc.: Viruses; Definitions, Intestinal viruses, Bacterial viruses and Fungal Viruses - Factors affecting growth of bacteria, mold and Yeast – nutrition, temperature, pH conditions, Carbon and Nitrogen Sources, Moisture and water activity; Redox potential, antimicrobial barriers and constituents

Unit II

Sources of microorganisms – Soil, water, Plants and of animal origin, Useful microorganisms – Lactic Acid Bacteria, Yeast, mold and fungi. Estimating number of microorganisms, sampling, sample size, aseptic collection of samples, total cell counts and viable cell counts, plate counters. Alternative methods – Dye-reduction tests, electrical methods, ATP determination – Rapid methods for the detection of specific organisms and toxins – Immunological methods and DNA/RNA methodology Microbiological quality control and HACCP

Unit III

Heat processing – Pasteurisation and appertization – determination of D and z values – heat sensitivity of micro-organisms – spoilage of canned foods – aseptic packaging Irradiation – Brief account of microwave, UV and ionizing radiation High pressure processing – Pascalisation Low-temperature storage – Chilling and freezing Use of chemical preservatives, Natural food preservatives. Brief overview of Modified storage packaging

Unit IV Microbiology of Food commodities

Cereals, Pulses, Nuts and Oilseeds, Fruits and Fruit products, Vegetables and Vegetable products

Unit V Food borne pathogens

Aeromonas hydrophila, Bacillus cereus, Brucella, Camphylobacter, Clostridium botulinum, Escherichia coli, Salmonella, Staphylococcus aureus, Scombrotic fish poisoning, Hepatitis A and B, Gastroenteritis viruses, Spongiform encephaolpathies

Text Books

1. W.C.Frazier: Food Microbiology (II edition or later) Mcgraw Hill Book Company, New York (1968)
2. M.R. Adams and M.O. Moss, Food Microbiology, Second Edition, Panima Publishing corporation, New Delhi. Third reprint 2004

References:

1. Gustavo F Gutierrez-Lopez, Gustavo V Barbosa-Canovas Food Science and Food Biotechnology: CRC Press 2003
2. Bibek Ray: Fundamental Food Microbiology, (Third Edition) CRC Press December 2003

MB210 FUNDAMENTALS OF BIOLOGICAL SYSTEMS

Credit : 3:0:0

Unit – I Biology of cells

Structure of prokaryotic and eukaryotic cells overview of organelles (Mitochondria, Chloroplasts, ER, Golgi, nucleus). Difference between plant and animal cell. Cellular membrane – Structure and functions- transport, endocytosis, role of membrane proteins as receptors. Cell cycle and regulation, cell division- mitosis and meiosis

Unit –II CELL – CELL interactions and signal transductions

Intercellular junctions, signaling by hormones and neurotransmitters, G protein receptors, protein kinesis, C & MP and inositol phosphates as second messengers.

Unit – III Microbiology

Classification and nomenclature of micro organisms, light and electron microscopy, principle of different staining techniques- gram staining, acid fast and capsular staining Physical and chemical control of microorganisms, Microbial biosensors

Unit – IV Molecular Genetics

Mendelian inheritance, DNA as genetic material, crossing over prokaryotic and eukaryotic genome organization.

Unit –V Molecular Biology

Replication in prokaryotes and eukaryotes Transcription- initiation, elongation, termination, Translation – Initiation; chain elongation of gene expression – Lac operon and Try operon

Text Book ;

P.S. Verma, V.K. Agarwal, Cell Biology, Genetics and molecular Biology. S. Chand and company 2000.

Reference Books

1. Pelzer. MJ, Chan ECS and Krein NR, Microbiology, Tata Mc Graw Hill Publishers, New Delhi 2000.
2. Lodish H, Bert A, Matsudaria Kaiser CA, Kriegar M, Scott MP, Zipursky SL, Darnell J, Molecular cell Biology, fifth edition, WH Freeman and company, New York, 2004.

MB211 COMMUNITY HEALTH AND SOCIAL AWARENESS

Credit : 3:0:0

Unit – I

Epidemiology, Etiology, Pathogenesis, Prevention and Control of Communicable Diseases, like Malaria, Cholera, Tuberculosis, Leprosy, Diarrhoea, ARI, Poliomyelitis, Viral Hepatitis, Measles, Dengue, Rabies, AIDS, etc.

Unit – II

Health planning in India including various committees and National Health Policy and Health Goals set from time to time.Organized sector with reference to centre, State, District and Block level structures and local bodies and Panchayat Raj.Organization and functions of community health centers and primary health centers

Unit – III

Problems of Population growth, Birthrates, death rates, fertility rates, age-specific mortality rates, MMR, CPR, etc.

Unit-IV

Environmental sanitation, Nutrition, Family Welfare and Planning, Reproductive and Child health

Unit – V

Objectives and organization of important agencies, like WHO, UNICEF, FAO, ILO, Indian Red cross Society, UNFPA, World Bank, Asia Development Bank, Ford Foundation, CARE, Rockefeller Foundation, etc. and their role in Health care activities in India.

Reference Books:

1. Park&Park, *Prevention and Social medicine*,.
2. Vidhyapooshan Sachdava, *An introduction to Sociology*

MB212 CELL BIOLOGY AND MICROBIOLOGY LAB

Credit: 0:0:1

6 experiments will be notified by the HOD from time to time

MB213 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credit: 0:0:1

6 experiments will be notified by the HOD from time to time

MB214 CELL BIOLOGY LAB AND MICROBIOLOGY LAB

Credit : 0:0:2

12 experiments will be notified by the HoD from time to time.

MB215 MOLECULAR BIOLOGY LAB AND GENETIC ENGINEERING LAB

Credit : 0:0:2

1. Isolation of genomic DNA from eukaryotic tissue (Plant or Animal)
2. Isolation of genomic DNA from microorganism (*E.Coli*)
3. Isolation of total RNA from eukaryotic tissue
4. Quantitative and qualitative analysis of isolated genomic DNA using spectrophotometer and by agarose gel electrophoresis
5. Elution technique for separated DNA from agarose gel
6. Extraction of proteins from plant or animal tissue and confirmation with qualitative tests
7. Separation and identification of serum proteins by SDS-PAGE using Coomassie Brilliant Blue stain
8. Western blotting for tissue extracted proteins or serum proteins separated in SDS-PAGE
9. Isolation of plasmid DNA from *E.Coli*
10. Restriction enzyme digestion of pUC19 plasmid DNA and testing with agarose gel electrophoresis
11. Ligation of fragmented pUC19 plasmid DNA and testing with agarose gel electrophoresis
12. Transformation competent cell preparation
13. Transformation of recombinant plasmid DNA into competent cells
14. Screening of recombinant transformants by Blue-White selection method
15. Polymerase Chain Reaction (PCR) for the given standard DNA using PCR kit and verifying with agarose gel electrophoresis
16. Optimization of inducer concentration (IPTG) for ß-galactosidase expression
17. Optimization of time of induction for ß-galactosidase expression

MB306 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credit : 0:0:2

1. Isolation of genomic DNA from eukaryotic tissue (Plant or Animal)
2. Isolation of genomic DNA from microorganism (*E.Coli*)
3. Isolation of total RNA from eukaryotic tissue
4. Quantitative and qualitative analysis of isolated genomic DNA using spectrophotometer and by agarose gel electrophoresis
5. Elution technique for separated DNA from agarose gel

6. Extraction of proteins from plant or animal tissue and confirmation with qualitative tests
7. Separation and identification of serum proteins by SDS-PAGE using Coomassie Brilliant Blue stain
8. Western blotting for tissue extracted proteins or serum proteins separated in SDS-PAGE
9. Isolation of plasmid DNA from *E.Coli*
10. Restriction enzyme digestion of pUC19 plasmid DNA and testing with agarose gel electrophoresis
11. Ligation of fragmented pUC19 plasmid DNA and testing with agarose gel electrophoresis
12. Transformation competent cell preparation
13. Transformation of recombinant plasmid DNA into competent cells
14. Screening of recombinant transformants by Blue-White selection method
15. Polymerase Chain Reaction (PCR) for the given standard DNA using PCR kit and verifying with agarose gel electrophoresis
16. Optimization of inducer concentration (IPTG) for ß-galactosidase expression
17. Optimization of time of induction for ß-galactosidase expression

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ADDITIONAL SUBJECTS

Code	Subject Name	Credits
CL217	Fundamentals of Thermal Fluid Sciences for Food Engineers	3:0:0
CL218	Process Engineering Calculations	3:0:0
CL219	Unit Operations in Food Processing I	3:0:0
CL220	Unit Operations in Food Processing II	3:0:0
CL221	Biochemical Thermodynamics	4:0:0
CL222	Unit Operations	4:0:0
CL223	Principle of Chemical Engineering	4:0:0
CL303	Advanced Chemical Engineering	4:0:0
CL304	Introduction to Biochemical Engineering	4:0:0
CL305	Advanced Chemical Engineering Lab	0:0:2

CL217 FUNDAMENTALS OF THERMAL FLUID SCIENCES FOR FOOD ENGINEERS

Credit: 3:0:0

Objectives

To enable the student to understand:

1. Basics of Fluid mechanics and thermal flow
2. Importance of thermal fluid sciences in processing of food
3. Develop processes with better heat efficiency and economics

Unit I: Introduction to Fluid Mechanics:

Fluids-Properties, Vapour pressure, surface tension, capillary effect; Types of fluids. Bernoulli equation; Fluid flow- laminar, turbulent; pressure drops in pipes, valves and bends. Orificemeter, Venturimeter, Rotameter, Pitot tube-working principles only.(Simple calculations).

Unit II: Introduction to thermodynamics

Thermodynamic system and Control volume, thermodynamic Properties, Thermodynamic equilibrium, thermodynamic process, Zeroth law of thermodynamics, concept of work and heat transfer. First law of thermodynamics –closed and open system, SFEE. Equation of state-ideal gas. Second law of thermodynamics. Properties of steam, dryness fraction, sensible heat, latent heat. (Simple problems in SFEE).

Unit III: Heat Transfer – Conduction

Modes of heat transfer –Conduction, Convection and Radiation. Steady heat conduction in simple geometries – Plane wall, cylindrical wall without heat generation. Transient heat conduction – Lumped capacitance method for bodies of infinite thermal conductivity Theory of insulation, critical radius of insulation Overall heat transfer coefficient (Derivation not required-Simple problems).

Unit IV: Heat Transfer – Convection and Radiation:
Convection heat transfer – forced and natural; Evaluation of convection heat transfer coefficient, turbulent flow over a flat plate, Forced convection inside tubes, heat transfer coefficient for Laminar flow in a tube with constant heat flux and constant wall temperature. Basics of Radiation heat transfer. (Derivation not required-Simple problems).

Unit V: Heat Transfer with phase change:

Boiling and condensation; Basic concepts multiphase flow; Pool boiling, Flow boiling. (Simple problems).

Text Book:

1. Yunus A.Cengel, Robert H.Turner.," Fundamentals of Thermal Fluid Science", Tata McGraw Hill,New Delhi,2005.

Reference Books:

1. R.K. Bansal, "A Text book of fluid Mechanics & Hydraulic Machines", Laxmi Publications (1992).
2. Kothandaraman,C,P., et al, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 3rd Edition, 1993.
3. Heat Transfer by P.K. Nag, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.

CL218 PROCESS ENGINEERING CALCULATIONS

Credit : 3:0:0

Objectives:

1. To study the various units and dimensions used for measurements.
2. To understand the various food processing operations with reference to balance of materials used and energy required.
3. To study the basic kinetic theory during food processing.

Unit I : Introduction to Food Engineering Calculations:
Systems of measurements; review of SI system of measurement; Units and Dimensions, Mole unit, conventions in methods of analysis and measurement, basis, temperature, pressure, chemical equations and stoichiometry

Unit II: Gases, Vapours, Liquids and Solids
Ideal Gas relationships, vapour equilibria for multi-component systems, material balances involving condensation and vaporization.

Unit III : Material Balances
Material balance of food processes involving Dilution, Concentration and Dehydration, Multistage processes and numerical examples

Unit IV : Energy Balances
Concept and units, calculations of enthalpy changes, general balance with or without reactions, heats of solution and mixing: Unsteady state material and energy balances.

Unit V: Kinetics of Chemical Reactions in Foods
Theory of reaction rates, types of reactions, enzymatic reactions, and reaction rate constant, temperature dependence of reaction rates

Text Books

1. Romeo T.Toledo: Fundamentals of Food Process Engineering, Van Nostrand Reinhold, New York (1991)
2. Himmelblau D.M. & J. B.Riggs: Basic Principles and Calculations in Chemical Engineering : Prentice Hall International, (7th Edition, 2004)

Reference Books

1. M. Loncin and R. L. Merson: Food Engineering, Principles and selected applications: Academic Press, London
2. Stanley E Charm: The fundamentals of Food engineering, AVI Publishing company, New York (1981)
3. J. Clair Batty and Steven L Folkman: Food Engineering Fundamentals, John Wiely & sons Publishers, New York

CL219 UNIT OPERATIONS IN FOOD PROCESSING I

Credit : 3:0:0

Objectives:

1. To study the engineering principles involved in processing of food materials.
2. To understand the various unit operations in food processing.
3. To study the mass transfer by gases and solvent extraction processes.

Unit I : Introduction
Basic principles of food processing, Conservation of mass and energy, Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

Unit II : Distillation
Distillation, Steam distillation, applications and equipment. Molecular distillation, theory and examples. Mass transfer phenomenon applied to food systems

Unit III : Evaporation
Needs, basic principles, Calculations, Single and multiple effect evaporation, Heat economy, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit IV : Contact Equilibrium Separation Processes

Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction. Extraction, with food application examples. Crystallization

Unit V : Super Critical Fluid Extraction

Super critical Fluid State, Properties of Super critical fluids, Density, Viscosity, Volatility etc. Supercritical Phase Equilibria, Solubility, Mass transfer operations, SCFE systems and components, Applications; extraction of Fatty acids, Hops, Essential oils and Bio chemicals; Relative advantages, limitations and economics

Text Books

1. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering - Vol 2 Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.
2. R.L.Earle: Unit Operations in Food Processing, (II Edition or later), Pergamen Press, New York

Reference Books

1. Albert Ebarz: Unit Operations in food Processing, CRC Press
2. Marcus Karel & Deryl B Lund: Physical Principles of Food Processing, Marcel Dekker Inc.
3. H.A.Lenigar and W.A.Beverlo: Food Process Engineering, D.Reidal Publishing Co, Boston, USA
4. H.S. Ramaswamy & M. Markotte: Food Processing Principles and Applications, CRC Press Ltd.
5. Dennis R. Heldman and R. Paul singh: Food Process Engineering (II Edition), AVI Publishing Company Inc. (1981)
6. Zacharias B. Maroulis and G. D. Saravacos: Food Process Design Marcel Dekker, USA (2003)

CL220 UNIT OPERATIONS IN FOOD PROCESSING II

Credit : 3:0:0

<u>Objectives</u>

To enable the student to understand:

1. Basics of mass transfer separations
2. Importance separation processes in designing a process
3. Develop processes with better efficiency and economics

Unit I : Adsorption and Diffusion

Basics of adsorption, Diffusion of gases in liquid and solid foods. Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components Applications of diffusion and migration in food packaging

Unit II : Mechanical Separations

Filtration and sedimentation, gravity sedimentation, Sedimentation of solid particles in gas media. Examples Industrial applications and equipments for Filtration and Sedimentation

Unit III : Centrifugal Separation

Sedimentation and filtration centrifuges, Basic equations. Different types of centrifuges – Basket, Tubular Bowl, Decanting, Disk bowl, Desludging (Self Cleaning) Bowl Centrifuges, Nozzle centrifuges. Importance of balancing of rotating masses, feed and discharge arrangement in each case. Specific characteristics, advantages and applications.

Unit IV : Membrane Filtration

Definitions; Reverse Osmosis (RO), Nano filtration (NF), Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.

Unit V : Roasting and Cooking

Theory, Different kinds of Roasters, Steam Cookers. Extrusion cooking. Single and Twin Screw Extruders. Forming extruders and snack food extruders. Advantages of Extrusion cooking over conventional cooking.

Text Books

1. R.L.Earle: Unit Operations in Food Processing, (II Edition or later), Pergamen Press, New York.
2. J. R. Butters, N. D. Cowell, and A. E. V. Lilley: Food Engineering Operations (Vol 1 and 2), Elsevier Publishing , 3rd Edition, 1990
3. J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering- Vol 2, Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.

Reference Books

1. G.M.Schneider, E. Stahl and G.Wilke: Extraction with Supercritical Gases, Verlag Chemie publishing, Basel
2. Rakesh Singh and S.H.Rizwi: Bio Separation Process in Foods, Marcel Dekker Inc. Hong Kong.
3. F.J. Fryer, D.L. Pyle and C.D. Rielly: Chemical engineering for the Food Industry, Blackie Academic and Professional, London, Chennai
4. Brennen: Food Engineering Operations (Vol 1 and 2), Elsevier Publishing
5. Jimmy L. Humphry and G. E. Keller: Separation Process Technology, Mcgraw Hill New York
6. A.S.Grandison and M.J.Lewis: Separation processes in the Food and Biotechnology industries (Principles and applications): Woodhead publishing Ltd. Cambridge UK
7. Maynord Joslyn and J.L.Heid: Food Processing Operations (3 Volumes) AVI Publishing company Inc. USA 1986

CL221 BIOCHEMICAL THERMODYNAMICS

Credit : 4:0:0

Unit –I: **Basic Concepts in Engineering Thermodynamics**

First and Second law of Thermodynamics; Calculation of Work, energy and property changes in reversible process, Thermodynamics of flow process; Power cycle and refrigeration cycles.

Unit –II: **Thermodynamics Properties of Fluids**
Volumetric properties of gases exhibiting non-ideal behavior, Residual properties; Estimation of Thermodynamics properties using equations of state; Maxwell relationship and their applications; Calculation of flow based on actual property changes.

Unit –III: **Phase and chemical reaction Equilibrium**
Criteria for phase equilibria; Vapour – liquid equilibrium calculations for binary mixtures, Liquid- Liquid equilibria and Solid – liquid equilibria , equilibrium criteria for homogeneous chemical reaction, Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant, Calculation of equilibrium conversions and yields for single and multiple chemical reactions.

Unit – IV: **Biosensors**
Definitions, immobilization and membranes, transducer combinations; Biosensor development and diversification, Conducto-metric biosensors, Direct Electron transfer biosensors and Optic biosensors, Practical forms of Biosensors, specific applications of biosensors.

Unit – V: **Biochemical Thermodynamics**
Energetic of Metabolic path ways, Energy Coupling (ATP& NADH), Stoichiometry and energetic analysis of cell Growth and PRODUCT FORMATION, Elemental Balances, Degree of reduction concepts available – electron balances, yield coefficients, Oxygen consumption and heat evolution in aerobic cultures, Thermodynamics efficiency of growth.

Reference Books:

1. J.M.Smith, H.C. Van Ness and M.M.Abbott, Introduction to Chemical Engineering Thermodynamics, Sixth edition, McGraw Hill, 2002.
2. Y.V.C. Rao, Chemical Engg. Thermodynamics, University press, 1999.
3. J.A. Roels, Kinetic and Energetic in Biotechnology, Elsevier, 1983

CL222 UNIT OPERATIONS

Credits: 4:0:0

Unit I Heat Transfer. **Basic considerations and conduction**
Importance of heat transfer in chemical and biotech operations , modes of heat transfer, mean temperatures.Concept of heat conduction, Fourier's law of heat conduction, Thermal conductivity, Heat conduction through the composite wall, Hollow spheres and hollow cylinder- steady state – unsteady state heat conduction. individual and overall heat transfer coefficients.

Unit – II. Convection and Radiations.
Concept of heat transfer by convection, Types of convection, application of dimensional

analysis for convection: Derive the equation for laminar , Transition and Turbulent conditions. Heat transfer from condensing Vapours, Heat transfer to boiling liquids. Heat transfer in packed and fluidized beds.Concept of Radiation- Laws of radiations, Grey and Black bodies.

Unit-III. Heat Exchanger

Heat exchanger – Types of flow- parallel and counter flow heat exchanger , LMTD, application of LMTD, Fouling factor - how to prevent the dirt factor. Types of heat exchanger , design of heat exchanger.Evaporator- Types of evaporators, Types of feeding, Calculations of Material and Energy balances ,concept of Evaporator capacity, Steam economy.

Unit-IV. Mechanical separation

Filtration - Types of filtration , Filter media , selection of medium, Filter aids – Filter theory , Types of filter – Constant pressure filtration, constant volume filtration.Industrial filtrations. Sedimentation, Batch sedimentation, free settling and Hindered settling. Centrifugal and centrifuge.

Unit – V. Mixing and Agitation

Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions, mixing of Powder, Viscous material and pastes. Agitator scale up, Particle Size, Stability, Visual Density, Stabilizers, Emulsifying – rpm, temperature, Reduction, Gear motor system.

Text Books

1. Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.
2. McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition.Mcgrawhill.1993.

Reference

1. Incropera F.P. Fundamentals Of Heat And Mass Transfer. John Wiley.1998

CL223 PRINCIPLE OF CHEMICAL ENGINEERING.

Credits: 4:0:0

Unit-I Importance of units and Basic Calculation.

Conversion factors- Atomic, molecular & equivalent weights- Molar concept- moles, mole fraction, weight fraction, mixtures and solutions.

Molarity, molality and normality- density, specific gravity. Ideal gas law-Ideal mixtures and solution-Dalton law of additive volumes, Concept of Simpson rules and its application

Unit – II. Material Balance with and without chemical reaction

Laws of conservation of mass- meaning of material balance and its applications-like distillation ,evaporation, crystallization, drying etc Material balance with Chemical reactions, limiting and excess reactant, recycle , bypass and purging, problems. Conservation of energy- Meaning of energy balance and its applications

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Unit- III. Fluid mechanics.
Nature of fluids - properties of fluids- Types of fluids, fluid static's- pressure measurements- Dimensionless analysis and similitude- Velocity potential ,continuity And mechanical energy equations, velocity profile and friction factor for smooth and rough surface pipes, Head losses for various stations..

UNIT –IV. **Fluid flow measurement**
Measurements of fluid flow – orifice meter, venturimeter, pitot tube, Rota meter, wires and notches.Flow controls - gate valve , needle valve , butterfly valve, globe and ball valve.. Fluidization- mechanism , types, its application. Friction factor for packed beds, Ergun equations.

Unit- V. **Transportation of Fluid**
Transportation of fluids – fluids moving machinery performance, Selection and specification, Air lift and diaphragm pumps positive displacement pumps, reciprocating pumps, centrifugal pumps, pump characteristics. Concepts of compressors, fans and blowers.

Text Books:
1. BI Bhatt &SM vora " Stoichiometry" Tata Mcgraw- Hill, Fourth Edition.
2. Chemical process calculation –by Ghavene – Delhi publications.
3. Transport Process and Unit operations-"Geankoplis" Prentice – Hall.

Reference:
1. Unit Operation of Chemical Engineering by McCabe and Smith- Harriot- Tata McGraw hill – 7 edition.
2. Unit operation of Chemical Engg " Chattopathya" Khanna publication- volume -1.

CL303 ADVANCED CHEMICAL ENGINEERING.

Credits: 4:0:0

Unit-I Importance of units and Basic calculation.
Conversion factors-Molar concept-moles, mole fraction, weight fraction, mixtures and solutions.Molarity, molality and normality-Ideal gas law-Ideal mixtures. Laws of conservation of mass-its applications ,Concept of Simpson rules and its application. Conservation of energy-Meaning of energy balance and its applications

Unit – II Fluid mechanics.
Nature of fluids - properties of fluids- Types of fluids, fluid static - pressure measurements- Dimensionless analysis and similitude-. Measurements of fluid flow and flow controls. Transportation of fluids, Various types of pumps.Pump Characteristics.Compressors and Blowers.

Unit-III Membrane Separation.

Membrane Separation process: Solid and Liquid membrane : Concept of Osmosis: Reverse osmosis: Electrodialysis: Their applications: Foam Separation process: Thermal and sweep diffusion process.

Unit-IV Heat Transfer:
Basic concept of heat transfer , mode of heat transfer, Fourier's law of heat conduction, Concept of convection and radiation. Heat exchanger, Types of Flow and LMTD, fouling factor. Design of exchanger..

Unit-V Mechanical Separation and mixing.
Filtration , types of filtration, Filter medium , filter aids, industrial filtrations. Sedimentation, batch sedimentation, centrifugal and centrifuge concept of mixing and agitations, mixing power calculation –high viscous materials and paste , agitator scale up.

Text Books:
1. BI Bhatt &SM vora " Stoichiometry" Tata Mcgraw- Hill, Fourth Edition.
2. Chemical process calculation –by Ghavene – Delhi publications.
3. Transport Process and Unit operations-"Geankoplis" Prentice – Hall.

Reference:
1. Unit Operation of Chemical Engineering by McCabe and Smith- Harriot- Tata McGraw hill – 7 edition.
2. Unit operation of Chemical Engg " Chattopathya" Khanna publication- volume -1.

CL304 INTRODUCTION TO BIOCHEMICAL ENGINEERING

Credit: 4:0:0

Unit I Introduction and overview of Fermentation Processes
Introduction, History of Biochemical engineering, Biotechnology and Biochemical engineering, need for Biochemical engineering,General requirements of fermentation Industry, Basic design and construction of a Fermentor and its ancillaries; Materials of construction, Vessel Geometry, Flow Measuring Devices, valves (Basic construction features)

Unit II Media Design and Sterilization for Fermentation processes
Medium requirements for fermentation processes, examples of simple and complex media, Design and usage of commercial media for industrial fermentations. Thermal death kinetics of microorganisms; Batch and continuous Heat- Sterilization of Liquid Media; Filter Sterilization of liquid Media and air sterilization, radiation and chemical sterilization. Sterilization equipment – batch and continuous.

Unit III Metabolic Stoichiometry and Bioenergetics
Thermodynamics, mass and energy balances in microbial metabolism, cell growth and product formation; metabolic heat generation. Stoichiometry of Cell growth and product formation - elemental balances, available – electron balances, degrees of reduction of

substrate and biomass; yield coefficients of biomass and product formation; maintenance coefficients; oxygen consumption and heat evolution in aerobic cultures.

Unit IV Transport phenomena in bioreactors

Mass transfer in heterogeneous biochemical reaction system: Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer coefficients (kla); role of aeration and agitation in oxygen transfer. Heat transfer processes in biological system.

Unit V Process design and operation of Bioreactors

Operational modes of reactors – batch, continuous, fed batch, repetitive batch, recycle and continuous cultivation; novel bioreactors: Stirred tank, air lift and loop reactor, packed – bed and hollow – fibre membrane bioreactors; reactors for waste – treatment processes; scale- up criteria for bioreactors.

Text Books:

1. Bailey J.E. and Ollis, D.F. Biochemical Engineering Fundamentals, McGraw Hill, (1986).
2. Shule and Kargi, Bioprocess engineering, Prentice Hall, Second Indian Reprint (2004).

References:

1. Karl Schugerl, Bioreaction Engineering (Volume 1), John Wiley (1987).
2. T.K. Ghose (Ed.), Process Computations in Biotechnology, Tata – McGraw Hill, 1(1994).
3. Atkinson, B. & Mavituna. F., Biochemical Engineering and Biotechnology Handbook, McGraw Hill (2nd Edition) (1993).
4. H.J. Rehm and G. Reed (Ed.), Biotechnology(Vol. 3, Bioprocessing), VCH (1993)
5. Harvey W. Blanch and Duoglas S. Clark, Biochemical Engineering, Marcel Dekker Inc.(1997)
6. Pauline Doran, Bioprocess Engineering Calculation, Academic Press, 1995

CL305 ADVANCED CHEMICAL ENGINEERING LAB

Credit: 0:0:2

1. Double pipe heat exchanger
2. shell and tube heat exchanger
3. plate type heat exchanger
4. screening analysis
5. packed bed distillation
6. ventur meter
7. orifice meter
8. fluidized bed column
9. packed bed column
10. heat loss due to contraction and expansion
11. thermal conductivity

SCHOOL OF BIOTECHNOLOGY

AND

HEALTH SCIENCES

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ADDITIONAL SUBJECTS

Subject Code	Subject Name	Credits
BT335	Advanced Reaction Engineering	4:0:0
BT336	Modern Separation Processes	4:0:0
BT337	Energy Management	4:0:0
BT338	Unit Operations and Processes in Effluent Treatment	4:0:0
BT339	Bio-Plant Design and Practice	4:0:0
BT340	Biological Wastewater Treatment	4:0:0
BT341	Molecular and Cellular Basis of Cancer	4:0:0
BT342	Advanced Biopharmaceutical Technology	4:0:0
BT343	Phytochemicals and Herbal Medicine	4:0:0
BT344	Advanced Plant Biotechnology	4:0:0
09BT201	Basic Industrial Biotechnology	4:0:0
09BT202	Instrumental Methods of Analysis	4:0:0
09BT203	Principles of Chemical Engineering	4:0:0
09BT204	Chemical Engineering Lab	0:0:2
09BT205	Unit Operations	4:0:0
09BT206	Mass Transfer Operations	4:0:0
09BT207	Biochemistry	4:0:0
09BT208	Analytical Biochemistry Lab	0:0:2
09BT209	Bio Organic Chemistry	4:0:0
09BT210	Cell Biology	4:0:0
09BT211	Microbiology	4:0:0
09BT212	Microbiology Lab	0:0:2
09BT213	Molecular Biology	4:0:0
09BT214	Genetic Engineering	4:0:0
09BT215	Molecular Biology & Genetic Engineering Lab	0:0:2
09BT216	Immunology & Immunotechnology	4:0:0
09BT217	Cell Biology and Immunology lab	0:0:2
09BT218	Bioprocess Principles	4:0:0
09BT219	Bioprocess Lab	0:0:2
09BT220	Enzyme Engineering & Technology	4:0:0
09BT221	Bioprocess Engineering	4:0:0
09BT222	Downstream Processing	4:0:0
09BT223	Downstream Processing Lab	0:0:2
09BT224	Metabolic Engineering	4:0:0
09BT225	Applied Plant & Animal Biotechnology	4:0:0
09BT226	Bioethics, IPR and Biosafety	4:0:0
09BT227	Basics of Bioinformatics	4:0:0
09BT228	Bioinformatics Lab	0:0:2
09BT229	Chemical Thermodynamics and Bio Thermodynamics	4:0:0
09BT230	Bio Reaction Engineering	4:0:0
09BT231	Advanced Bioprocess Lab	0:0:2
09BT232	Protein Engineering	4:0:0
09BT233	Plant Biotechnology	4:0:0

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09BT234	Animal Biotechnology	4:0:0
09BT235	Cancer Biology	4:0:0
09BT236	Bioprocess Economics and Plant Design	4:0:0
09BT237	Applied Environmental Biotechnology	4:0:0
09BT238	Introductory Genomics and Proteomics	4:0:0
09BT239	Bio Pharmaceutical technology	4:0:0
09BT240	Nano Biotechnology	4:0:0
09BT241	Analytical Techniques in Biotechnology Lab	0:0:2
09BT242	Introductory Biotechnology	3:0:0
09BT243	Applied Microbiology	3:0:0
09BT244	Introductory Cell Biology	3:0:0
09BT245	Introductory Genetic Engineering	3:0:0
09BT246	Role of Biotechnology in Environment	3:0:0
09BT247	Basics of Biomolecules	3:0:0
09BT248	Gene and Gene Expression	3:0:0
09BT249	Introductory Microbial Biotechnology	3:0:0
09BT250	Applied Biotechnology	3:0:0
09BT251	Instrumental Methods of Analysis	3:0:0
09BT252	Nanobiotechnology	3:0:0
09BT253	Cancer Biology	3:0:0
09BT254	Basic Research Methodology	2:0:0
09BT255	Animal and Plant Tissue Culture Lab	0:0:2
09BT256	Industrial Safety	3:0:0
09BT257	Renewable Energy System	3:0:0
09BT258	Bioremediation for Industrial Sectors	3:0:0
09BT301	Cell Biology and Advanced Biochemistry	4:0:0
09BT302	Cell Biology and Advanced Biochemistry Lab	0:0:2
09BT303	Biochemical Engineering	4:0:0
09BT304	Chemical and Biochemical Engineering Lab	0:0:2
09BT305	Advances in Genetic Engineering	4:0:0
09BT306	Genetic Engineering Lab	0:0:2
09BT307	Advanced Bioprocess Engineering	4:0:0
09BT308	Bioprocess Engineering and Downstream processing Lab	0:0:2
09BT309	Metabolic Regulations and Engineering	4:0:0
09BT310	Advanced Immunotechnology	4:0:0
09BT311	Immunotechnology Lab	0:0:2
09BT312	Advanced Biopharmaceutical Technology	4:0:0
09BT313	Downstream Processing in Biotechnology	4:0:0
09BT314	Analytical Biotechnology Lab	0:0:2
09BT315	Research Methodology	4:0:0
09BT316	Instrumentation and Biotechniques	4:0:0
09BT317	Advanced Reaction Engineering	4:0:0
09BT318	Modern Seperation Processes	4:0:0
09BT319	Energy Management	4:0:0
09BT320	Unit Operations and Processes in Effluent Treatment	4:0:0
09BT321	Bio-Plant Design and Practice	4:0:0

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09BT322	Biological Waste Water Treatment	4:0:0
09BT323	Molecular and Cellular Basis of Cancer	4:0:0
09BT324	Phytochemicals and Herbal Medicine	4:0:0
09BT325	Advanced plant Biotechnology	4:0:0
09BT326	Basics of Chemical Engineering (Bridge course)	3:0:0
09BT327	Research Methodology	3:0:0
09BT328	Animal and Plant Tissue Culture Lab	0:0:2

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BT335 ADVANCED REACTION ENGINEERING

Credit : 4:0:0

Unit I Kinetics of Heterogeneous Reactions

Catalytic reactions, rate controlling steps, Langmuir-Hinshelwood model, Rideal-Eiley mechanism, steady state approximation, non-catalytic fluid-solid reactions, shrinking and un-reacted core model. Biological reactions in fermentation processes

Unit II External Diffusion Effects in Heterogeneous Reactions

Mass and heat transfer coefficients in packed beds, quantitative treatment of external transport effects, modeling diffusion with and without reaction.

Unit III Internal Transport Processes in Porous Catalysts

Inter pellet mass and heat transfer, evaluation of effectiveness factor, mass and heat transfer with reaction.

Unit IV Analysis and Design of Heterogeneous Reactors

Isothermal and adiabatic fixed bed reactors, non-isothermal and non-adiabatic fixed bed reactors. Two – phase fluidized bed model, slurry reactor model, and trickle bed reactor model. Experimental determination and evaluation of reaction kinetics for heterogeneous systems.

Unit-V Bio Chemical Reaction system.

Enzyme fermentation, microbial fermentation introduction and overall picture, substance – limiting microbial fermentation, product limiting microbial fermentation

References:

1. Carberry, J.J., Chemical and Catalytic Reaction Engineering, McGraw Hill, New York, 1976.
2. Froment, G.F. and Bischoff, K.B., Chemical Reactor Design and Analysis, 2nd Edition, John Wiley & Sons, New York, 1997.
3. Octave Levenspial, Chemical reaction engineering 3rd Edition, John Wiley & Sons, New York, 1999.

BT336 MODERN SEPARATION PROCESSES

Credit : 4:0:0

Unit I

Review of conventional processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, process concept, Theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid-liquid separations involving a second liquid.

Unit II

Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors, centrifugal separators and their relative merits, Commercial, pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis. Economics of membrane operations, Ceramic membranes.

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Unit III
Mechanisms, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno Chromatography, Types of equipment and commercial process, Recent advances and process economics.

Unit IV
Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electro dialysis, Commercial processes.

Unit V
Separations involving lyophilisation, Pervaporation and permeation techniques for solids, liquids and gases, Industrial viability and examples, Zone melting, Adductive crystallization, Other separation processes, Supercritical fluid extraction, Oil spill Management , Industrial effluent treatment by modern techniques.

References:
1. King, C.J., Separation Processes. Tata McGraw Hill, 1982.
2. Roussel,R.W., Handbook of Separation Process Technology, John Wiley, New York, 1987.
3. Nakagawal, O.V., Membrane Science and Technology, Marcel Dekker, 1992.

BT337 ENERGY MANAGEMENT

Credit : 4:0:0
Unit I
Energy sources; coal oil, natural gas; nuclear energy; hydroelectricity, other fossil fuels; geothermal; supply and demand; depletion of resources; need for conservation; uncertainties; national and international issues-Ozone layer depletion, photosynthesis-Global warming
Unit II
Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources. Energy; various forms; energy storage; structural properties of environment.

Unit III
Bio-geo-chemical cycles; society and environment population and technology. Energy and evolution; growth and change; patterns of consumption in developing and advances countries; commercial generation of power requirements and benefit.

Unit IV
Chemical industries; Classification; conservation in unit operation such as separation; cooling tower; drying; conservation applied to Bio-fertilizers, cement, pulp and paper, food industries, fermentation, pharmaceutical industries; conservation using optimization techniques.

Unit V

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Sources of continuous power; wind ,Biogas-pyrolysis ; geothermal; tidal and solar power; MHD, fuel cells; Bio-fuel. Cost analysis; capacity, production rate, system rate; system cost analysis; corporate models; production analysis and production using fuel inventories, input-output analysis, economics; tariffs. Energy generation from Bio-wastes.

References:

1. Krentz, J.H., Energy conservation and utilization, Allyn and Bacur Inc., 1976.
2. Gramlay, G.M., Energy, Macmillan Publishing Co., New York, 1975.
3. Rused, C.K., Elements of Energy Conservation, McGraw-Hill Book Co., 1985.

BT338 UNIT OPERATIONS AND PROCESSES IN EFFLUENT TREATMENT

Credit : 4:0:0

Unit I

Selection of unit operations and processes- Principal type of Reactors- Screening – Mixing – Coagulation and Flocculation – Flow equalization.

Unit II

Sedimentation – Type of settling – Removal ratio – Clarifier – thickener – Column flotation – air floatation. Solid waste management in Biochemical industries

Unit III

Filtration – classification of filters – Head loss through filters – Darcy - equation.

Unit IV

Chemical precipitation – phosphate removal – Adsorption – Activated carbon – isotherms – Disinfection – Factors influencing – Breakpoint chlorination – Dechlorination.

Unit V

Kinetics of biological growth – Suspended and attached growth processes – Aerobic and Anaerobic – Determination of kinetic coefficients.

References:

1. METCALF & EDDY, INC. “Wastewater Engineering–Treatment, Disposal, and Reuse “, Third Edition, Tata McGraw-Hill, 1995.
2. Casey. T.J.”Unit Treatment Processes in Water and Wastewater Engineering”, John Wiley & Sons. 1993

BT339 BIO-PLANT DESIGN AND PRACTICE

Credit : 4:0:0

Unit I Plant Design

Fomenter design, reactions vessels, piping and valves for biotechnology, Pressure relief system. Materials of construction and properties. Utilities for plant design.

Unit II Process economics

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General fermentation process economics, materials usage and cost, capital investment estimate, production cost estimate. Two case studies – one traditional product and one recombinant product.

Unit III Pharmaceutical water system
Grades of water, sanitary design, water treatment system, water distribution system, validation-Sanitary design principles : Biochemical, food and pharma industries

Unit IV Validation of Biopharmaceutical Facilities
Introduction, Why Validation, when does validation occur, Validation Structure, Resources for validation, validation of Systems And Processes including Sip And Cip- Hazardous analysis: Food, Pharma and Biotech industries.

Unit V Good manufacturing Practices
Structure – quality management, personal, premises and equipment. Documentation, production, quality control, contract manufacturing and analysis, complaints and product recall, self inspection. Introduction to GLP and its principles.

References:
1. Peter, Max S. and Timmerhaus, Klaus D., " Plant Design and Economics for Chemical Engineers ", 5th Edition, McGraw Hill.1997.
2. "A Compendium of Good Practices in Biotechnology ", BIOTOL Series, Butterworth-Heiemann,1993
3. Seiler,Jiing P., "Good Laboratory Practice; The why and How ?", Springer, 2001.
4. Lydersen, B.K. etal., "Bioprocess Engineering Systems, Equipment and Facilities",John-Wiley,1994.

BT340 BIOLOGICAL WASTEWATER TREATMENT

Credit : 4:0:0
Unit I
Classification of Biochemical operations, fundamentals of biochemical operations, Stoichiometry and Kinetics of Biochemical Operations.

Unit II
Theory, modeling of ideal suspended Growth Reactors, Modeling Suspended Growth Systems. Aerobic Growth of Heterotrophs in a single Continuous Stirred Tank, Reactor Receiving Soluble Substrate, Multiple Microbial Activities in a Single Continuous Stirred Tank Reactor, Multiple Microbial Activities in Complex Systems, Techniques for Evaluating Kinetics and Stoichiometric parameters.

Unit III
Applications: Suspended Growth Reactors, Design and Evaluation of Suspended Growth Processes, Activated Sludge, Biological Nutrient Removal, Aerobic – digestion, Anaerobic Processes, Lagoons.

Unit IV

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Theory: Modeling of Ideal Attached Growth Reactors, Bio-film Modeling. Aerobic Growth of Biomass in Packed Towers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

Unit V

Applications: Attached Growth Reactors, Trickling Filter, Rotating Biological Contactor, Submerged Attached Growth Bioreactors, Future Challenges, Fate and Effects of Xenobiotic Organic Chemicals.

References

1. Graty. C.P.L.Daigger, G and Lim, H.C, Biological Wastewater Treatment. 2nd Edition, Marcel Dekker, 1998
2. Mizahi A, Biological Waste Treatment, John Wiley Sons Inc 1989.

BT341 MOLECULAR AND CELLULAR BASIS OF CANCER

Credit: 4:0:0

UNIT I Cancer Biology: the Basics

Introduction, historical perspective and classification of cancer;
Carcinogenesis: Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X-ray and UV radiation-mechanisms of radiation carcinogenesis.
Cancer initiation, promotion, & progression, screening and early detection, Tumour markers

UNIT II Cell cycle regulation and Signal Transduction

Cancer cell cycles; Cell cycle control genes and mismatch repair genes; Growth factors, growth factor receptors and Signal transduction; Growth factor receptor kinases and cytoplasmic tyrosine kinases; Ras/MAPK pathway; Cyclic AMP and activation of CREB; JAK-STAT pathway; Transcription factors; Telomerases

UNIT III Oncogenes and Tumour Suppressor Genes

Apoptosis; Cellular proto-oncogenes and oncogene activation; Retroviral oncogenes; Tumour supressor genes; Retino Blastoma tumour suppressor genes and its significance. Tumour suppressor gene pathways; DNA methylation and epigenetic silencing of suppressor genes.

UNIT IV Understanding Natural History of Cancer Development

Free radicals, antioxidants and cancer; Metabolic oxidative stress and cancer; Genetic changes of selected cancers – Lung cancer, Breast cancer, Gastrointestinal cancers and other cancers; Cell-cell interactions, cell adhesion, angiogenesis, invasion and metastasis; Tumour associated antigens and Tumour specific antigens

UNIT V Current Concepts in Cancer Therapy

Different forms of therapy – Chemotherapy, radiation therapy, surgery; Gene therapy and cancer; Applications of Monoclonal antibodies in cancer diagnosis and therapy.
Cancer immunity and strategies of anticancer immunotherapy;
Natural products and cancer; Immunomodulators in cancer therapy; diet and cancer.

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Text Books

1. Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2. Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce. The Biological Basis of Cancer. Cambridge University Press, New York 2003.
3. Macdonald F and Ford CHJ. Molecular Biology of Cancer. Bios Scientific Publishers, 1997.

BT342 ADVANCED BIOPHARMACEUTICAL TECHNOLOGY

Credit : 4:0:0

UNIT- I FUNDAMENTALS OF PHARMACY PRACTICE

Pharmaceutical Biotechnology: An introduction, Origin & definition, Scope & Importance of Biotechnology; their applications, Microbes in Pharmaceutical industry, Methods of Gene transfer, Biotechnology production of Secondary Metabolites

UNIT- II PHARMACOKINETICS AND PHARMACODYNAMICS

ADME properties- Mechanism of Drug Absorption, Distribution of drugs, Drug metabolism (Biotransformation of drugs), Excretion of drugs, Pharmacokinetics: Basic considerations. Mechanism of drug action.

UNIT- III PHARMACEUTICAL DOSAGE AND DRUG DELIVERY SYSTEM

Materials & Formulations, Manufacture of Tablets, Capsules, Sustained Release dosage forms, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols. Drug delivery system – Formulation of proteins and peptides. Protein as drug delivery system. Controlled drug delivery system- transdermal. Novel drug delivery system- liposomes

UNIT IV PHARMACEUTICAL ANALYTICAL TECHNIQUES

UV-Visible spectroscopy, Flame emission spectroscopy and atomic absorption Spectroscopy, Fluorimetry, Infrared spectrophotometry, Nuclear magnetic resonance spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, Chromatographic techniques, Electrophoresis, Radio immuno assay, X-ray diffraction methods.

UNIT V BIOLOGICAL PRODUCTS

Properties of biotechnology derived therapeutic products. Production of Human insulin, Interferons, somatotropin, human growth hormone, somatostatin, purification, characterisation & analysis- establishing safety & efficacy. Gene Therapy, vaccines, Monoclonal Antibody Based Pharmaceuticals, Recombinant Human Deoxyribonuclease

TEXT BOOKS

1. Pharmaceutical Biotechnology by S.S. Purohit, H.N. Kakrani and A.K. aluja. Jodhpur, Agrobios, 2003.

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2. Biopharmaceutics and Pharmacokinetics-A Treatise by DM Brahmankar, Sunil B Jaiswal
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, H., Allen, L., Popovich, N.1999. Williams & Wilkins. (7th edition).
4. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.

REFERENCES

1. Pharmaceutical Biotechnology Concepts and Applications by Gary Walsh
2. Industrial Pharmaceutical Biotechnology , H. Klefenz, Wiley-VCH, 2002
3. Pharmaceutical Biotechnology, edited by Michael J. Groves, Second Edition
4. Instrumental Methods of Analysis – Hobert H. Willard, 7th Edition.

BT343 PHYTOCHEMICALS AND HERBAL MEDICINE

Credit : 4:0:0

Unit I: Crude Drugs

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs.
Indian System of medicine: Ayurveda, Siddha and Unani and its significance

Unit II: Medicinal & Aromatic Plants

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs. Modern Biotechnological tools and its influence in Medical and Aromatic plant cultivation.

Unit III: Tissue Culture of medicinal Plants

Plant Tissue Culture as source of medicines, Secondary metabolite production in plants; Plant Tissue Culture for enhancing secondary metabolite production (*Withania somnifera, Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata, Dioscorea sp*.); Anticancer, Antiinflammatory, Antidiabetic, Analgesicdrugs, Biogenesis of Phytopharmaceuticals.

Unit IV: Analysis of Phytochemicals

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical). Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods. Characterization of drugs.
Types of Phytochemicals:
Carbohydrates & derived products; Glycosides - extraction methods (Digitalis, Aloe, Dioscorea,); Tannins (Hydrolysable & Condensed types); Volatile Oils - extraction methods (Clove, Mentha); Alkaloids - extraction methods (Taxus, Papaver, Cinchona); Flavonoids-extraction methods, Resins- extraction methods; Lectins.

Unit V:Applications of Phytochemicals

Application of phytochemicals in industry and healthcare; Biocides, Biofungicides, Biopesticides. Nutraceuticals and their significance.

Text Books:

1. Pharmacognosy, C. K. Kokate, A. P. Purohit & S. B. Gokhale (1996), Nirali Prakashan, 4th Ed.

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2. Natural Products in medicine: A Biosynthetic approach (1997), Wiley.

References

1. Hornok,L. (ed.) (1992). Cultivation & Processing of Medicinal Plants, Chichister, U. K:J. Wiley & Sons.
2. Trease & Evans, Pharmacognosy – William Charles Evans, 14th ed. (1989), Harcourt Brace & Company.

BT344 ADVANCED PLANT BIOTECHNOLOGY

Credit : 4:0:0

UNIT-I: Genetic engineering: Introduction to Gene Manipulation. Basic Techniques: Isolation and purification of Nucleic Acids (DNA, RNA), Agarose Gel Electrophoresis, Pulsed field electrophoresis. Southern, Northern and western blotting, PCR, .Converting mRNA transcripts into cDNA libraries, functional sequencing of cDNA Expression libraries.

UNIT-II: Methods in genetic: enzymes as molecular tools - uses of restriction enzymes in plant genetic engineering, DNA modifying enzymes and their applications in recombinant DNA technology. Preparation of probes, nucleotide labling, radiolabling and alternatives, molecular probes. Nucleic acid microarray, gene knock out and silencing and RNAi.

UNIT-III: Methods of gene transfer in plants: transient and stable gene transformation. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation, silicon carbide mediated and floral dip method.

UNIT-IV: Plant transformation technology: *Agrobacterium tumefaciens* as plant genetic engineer: features of Ti and Ri plasmids, use of Ti and Ri as vectors, binary vectors, viral vectors and their applications.

UNIT-V: Application of plant transformation for productivity and performance: herbicide resistance, phosphoinothricin, glyphosate, sufonyl urea, atrazine, insect resistance, Bt genes, virus resistance, coat protein mediated, nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, antifungal proteins, thionins, PR proteins, nematode resistance, use of ACC synthase, polygalacturanase, ACC oxidase, carbohydrate composition and storage, ADP glucose pyrophosphatase. Golden rice, blue rose. Edible vaccines.

References

1. Introduction to Plant Biotechnology by H.S. Chawla, 2002. Oxford and IBH P Publishing Co.Pvt. Ltd. New Delhi.
2. Plant molecular genetics by Monica. A. Hughes.1999. Pearson Education limited, England.
3. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2001
4. An introduction to genetic engineering in plants, Mantel S.H, Mathews
5. J.A. Mickee R.A.1985. Blackwell Scientific Publishers. London
6. R.C. Dubay. A Text Book of Biotechnology. 2001. S.Chand & Campany Ltd.,

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7. Glick and Pasternak, Molecular Biotechnology. 2001.

09BT201 BASIC INDUSTRIAL BIOTECHNOLOGY

Credit : 4:0:0

Objective

To impart the knowledge on Historical overview of Biotechnology, production of some commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures. Production of recombinant proteins

Outcome

At the end of the course, the students would have learnt about the steps involved in the production of bioproducts and methods to improve modern biotechnology

Unit – I Introduction to Industrial Bioprocess (13)

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

Unit – II Production of Primary Metabolites (13)

A brief outline of processes for the production of some commercially important Organic acids: citric acid, lactic acid, acetic acid; Amino acids: glutamic acid, lysine, phenyalanine, aspartic acid and Alcohols: ethanol, butanol.

Unit – III Production of Secondary Metabolites (13)

Study of production processes for various classes of secondary metabolites: Antibiotics- Beta-lactams: penicillin, cephalosporin, Aminoglycosides: streptomycin, Macrolides: erythromycin, Vitamins: Vit.B12, B2, Vit.A and Steroids.

Unit – IV Production of Enzymes and Other Bioproducts (13)

Production of Industrial Enzymes: proteases, amylases, lipases, cellulases and Enzyme Inhibitors: inhibitors of cholesterol synthesis. Production of Biopesticides, Biofertilisers, Biopreservatives: Nisin, Cheese, Biopolymers: xanthan gum, PHB and Single cell protein.

Unit – V Production of Modern Biotechnology Products (13)

Production of recombinant proteins having therapeutic and diagnostic applications: vaccines, monoclonal antibodies. Products of plant and animal cell cultures.

Total : 65 hours

Text Book:

1. Casida Jr, L.E., Industrial Microbiology, New Age International (P) Ltd. (2000).
2. Wulf Cruger and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation. (2003)

Reference Books:

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1. Presscott, Dunn, Industrial Microbiology, Agrobios (India).2006

2. *Murrey Moo & Young, Comprehensive Biotechnology, Pergamon.2007*
3. Ratledge & Kristiansen, Basic Biotechnology, IInd edition,; Cambridge University press. 2004.

09BT202 INSTRUMENTAL METHODS OF ANALYSIS

Credit: 4:0:0

Objective

To develop skills of students in instrumentation and biological techniques.

Outcome

At the end of this course, the students would have learnt about principles of spectroscopy, nephelometry & chromatography and all biotechniques

Unit I Centrifugation and pH Measurement: (13)

Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H_2 electrode and glass electrode. calibration of instrumental methods, Centrifugation- Principle and Types.

Unit II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer (13)

Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

Unit III Chromatography and Electrophoresis (18)

Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC. Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis, supporting materials-paper, starch, agarose, polyacrylamide.

Unit IV Radio active techniques (13)

Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Autoradiography, Applications in Medicine & Diagnosis.

Unit V Thermo Analytical Techniques (8)

Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC)

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Total: 65 Hours

Text Book:

1. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 2002.
2. Instrumental Methods of Analysis, D. Skoog, 2000.

Reference Books:

1. Ewing GW, Instrumental methods of Chemical Analysis, McGraw Hill Book Company, 1989.
2. Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987

09BT203 PRINCIPLES OF CHEMICAL ENGINEERING

Credits: 4:0:0

Objective

To develop skills of students in principles and basic calculations of chemical Engineering.

Outcome

To familiarize

- Units and Basic calculation
- Conservation and application
- Study of fluids
- Mechanism of Fluidization
- Transportation of fluids

Unit-I Importance of units and Basic Calculation (13)

Conversion factors- Atomic, molecular & equivalent weights- Molar concept- moles, mole fraction, weight fraction, mixtures and solutions. Morality, modality and normality- density, specific gravity. Ideal gas law-Ideal mixtures and solution-Dalton aw of additive volumes, Concept of Simpson rules and its application

Unit – II. Material Balance with and without chemical reaction (13)

Laws of conservation of mass- meaning of material balance and its applications-like distillation ,evaporation, crystallization, drying etc Material balance with Chemical reactions, limiting and excess reactant, recycle , bypass and purging, problems. Conservation of energy- Meaning of energy balance and its applications

Unit- III. Fluid mechanics (13)

Nature of fluids - properties of fluids- Types of fluids, fluid static's- pressure measurements- Dimensionless analysis and similitude- Velocity potential ,continuity And mechanical energy equations, velocity profile and friction factor for smooth and rough surface pipes, Heads losses for various stations..

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UNIT –IV. Fluid flow measurement (13)

Measurements of fluid flow – orifice meter, venturimeter, pitot tube, Rota meter, wires and notechs. Flow controls - gate valve , needle valve , butterfly valve, globe and ball valve.. Fluidization- mechanism , types, its application. Friction factor for packed beds, Ergun equations.

Unit- V Transportation of Fluid (13)

Transportation of fluids – fluids moving machinery performance, Selection and specification , Air lift and diaphragm pumps positive displacement pumps, reciprocating pumps, centrifugal pumps , pump characteristics. Concepts of compressors , fans and blowers.

Total : 65 hours

Text Books:

1.BI Bhatt &SM vora " Stoichiometry" Tata Mcgraw- Hill, Fourth Edition. 2004.
2.Chemical process calculation –by Ghavene – Delhi publications.2007

Reference Books:

1.Unit Operation of Chemical Engineering by McCabe and Smith- Harriot- Tata McGraw hill – 2001.
2.Unit operation of Chemical Engg " Chattopathya" Khanna publication- volume -1,2002
3. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.
4. Felder R.M. and Rousseau R.W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley and Sons, Inc., 2000.
5. V. Venkataramani and N.Anantharaman., Process Calculations., 2003

09BT204 CHEMICAL ENGINEERING LAB

Credit: 0:0:2

List of Experiments:

1. Flow measurement through orifice meter
2. Flow measurement through venture meter
3. Head loses in pipe fitting
4. Pressure drop in fluidized bed column
5. Pressure drop in packed bed column
6. Flow through helical coil of different diameter pipe
7. Over all heat transfer coefficient in plate heat exchanger
8. Over all heat transfer coefficient in shell& tube heat exchanger
9. Over all heat transfer coefficient in double pipe heat exchanger
10. Screening Analysis

09BT205 UNIT OPERATIONS

Credits: 4:0:0

Objective

This course aims at making the students understand the fundamental principles and concepts of heat transfer and mechanical operation in biochemical processes.

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Outcome

To expose the students of biotechnology to

- Principles and mechanism of heat transfer
- Fundamentals of convectional heat transfer
- Basic principles of heat exchanger design
- Concepts of drying and thermal processing of biological materials

Unit–I Heat Transfer. Basic considerations and conduction (13)

Importance of heat transfer in chemical and biotech operations , modes of heat transfer, mean temperatures. Concept of heat conduction, Fourier's law of heat conduction, Thermal conductivity, Heat conduction thro the composite wall , hallo spheres and hallo cylinder- steady state – unsteady state heat conduction. individual and overall heat transfer coefficients.

Unit – II. Convection and Radiations (13)

Concept of heat transfer by convection, Types of convection, application of dimensional analysis for convection: Derive the equation for laminar , Transition and Turbulent conditions. Heat transfer from condensing Vapours, Heat transfer to boiling liquids. Heat transfer in packed and fluidized beds. Concept of Radiation- Laws of radiations, Grey and Block bodies.

Unit-III. Heat Exchanger (13)

Heat exchanger – Types of flow- parallel and counter flow heat exchanger , LMTD, application of LMTD, Fouling factor - how to prevent the dirt factor. Types of heat exchanger , design of heat exchanger. Evaporator- Types of evaporators, Types of feeding, Calculations of Material and Energy balances ,concept of Evaporator capacity, Steam economy.

Unit-IV. Mechanical separation (13)

Filtration - Types of filtration , Filter media , selection of medium, Filter aids – Filter theory , Types of filter – Constant pressure filtration, constant volume filtration. Industrial filtrations. Sedimentation, Batch sedimentation, free settling and Hindered settling. Centrifugal and centrifuge.

Unit – V. Mixing and Agitation (13)

Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions, mixing of Powder, Viscous material and pastes. Agitator scale up, Particle Size, Stability, Visual Density, Stabilizers, Emulsifying – rpm, temperature, Reduction, Gear motor system.

Total : 65 hours

Text Books:

1.Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.
2.McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition.Mcgrawhill.1993.

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Reference Books:

1. Incropera F.P. Fundamentals Of Heat And Mass Transfer. John Wiley.1998

09BT206 MASS TRANSFER OPERATIONS

Credits: 4:0:0

Objective

- To introduce the mass transfer principles
- To study the vapor liquid equilibrium
- To teach the concept s liquid - liquid equilibrium
- To study in detail the principles of adsorption
- To introduce the concept of membrane separation

Outcome

At the end of the course the students would have learnt about the basics of the mass transfer process in biotechnological process.

Unit-I Diffusion in fluids ***(13)***

Molecular and Eddy diffusion in a gas and liquid , Steady state diffusion under stagnant and laminar flow condition. Diffusion measurement and calculations. Ordinary diffusion in multicomponents gaseous mixtures, diffusion in solids . Interface mass transfer , Theory of mass transfer , Concept of mass transfer coefficient, overall mass transfer coefficient , Analgies between momentum and mass transfer coefficients.

Unit-II Distillation ***(13)***

Vapour – Liquid equilibrium diagram, Raoults law derivations from ideality , methods of distillation – Batch and continuous distillation. Types of distillation – Simple distillation , flash distillation, Fractional distillation. Design calculations of by McCabe –Thiele method and Ponchon Savarite methods. Various industrial distillation – Extractive distillation , molecular distillation, Azeotropic distillation, steam distillation.

Unit –III Absorption ***(13)***

Theories of gas absorption, Desgn of absorption towers , absorption with chemical reaction, Types of packing and Characteristics , Concept of NTU and HTU.

Unit – IV Adsorption Ion-Exchange ***(13)***

Theories of adsorption of gases and liquids : industrial adsorbents. Adsorption equipments for batch and continuous operation. Principles of Ion –Exchange, Industrial equipments .

Unit – V Leaching and Extraction ***(13)***

Solid – liquid equilibrium, Leaching equipment- Batch and continuous types: Calculations of number of stages. Equlibrium in ternary systems , batch and continuous extractors. different contact Extractors.

Total : 65 hours

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Text books:
1.R.E Treybal, " Mass Transfer Operations" McGraw Hill-2003
2. Mass transfer –II K.A.gavhane,Nirali publications,2007

Reference books:
1.Unit operation of Chemical Engineering – Chattophathya – Khanna publication-2005
2.W.L McCabe Smith and Harriot P " Unit Operations of Chemical Engineering" Sixth edition McGraw Hill , International edition, 2001
3.Unit operations of chemical engg,Mc Cabe & Smith, Tata McGraw Hill, 7th edn, 2005
4.Chemical engineering,coulsion Richardson,vol-2,2003
5.Introduction to chemical engineering,badger and banchero, Tata McGraw Hill, 7th edn, 2005

09BT207 BIOCHEMISTRY

Credit: 4:0:0
Objective
To study about the structure, composition and function of various biomolecules
Outcome
At the end of the semester the students will enable to understand the metabolism of carbohydrates, lipids, proteins and the bioenergetics.

Unit - I: Structure and Properties of Carbohydrates and Lipids (13)
Structure and properties of mono, di, oligo and polysaccharides, complex carbohydrates-Structural and functional relationships. Structure and properties of fatty acids, phospholipids, sphingolipids, glycolipids and cholesterol.

Unit – II : Structure and Properties of Proteins and Nucleic Acids (13)
Structure and properties of amino acids, modified amino acids, peptides, proteins, conjugated proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides - ribonucleic acids and deoxy ribonucleic acids, nucleoprotein complexes.

Unit – III : Intermediary Metabolism And Bioenergetics (13)
Overview of intermediary metabolism: Interconnections of metabolic pathways. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle.

Unit – IV : Metabolism Of Carbohydrates and Lipids (13)
Lipid Metabolism: Biosynthesis and biodegradation of fatty acids and cholesterol.
Carbohydrate Metabolism: Glycolysis, pentose phosphate pathway, TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis. Inborn errors of carbohydrate metabolism.

Unit-V: Metabolism Of Proteins And Nucleic Acids (13)
Biodegradation of proteins. Biosynthesis and biodegradation of important amino acids- Leu, Thr, Met, Lys, Tyr, Phe, Trp, Glutamate and Cys Transamination and Urea Cycle, Biosynthesis and biodegradation of purines and pyrimidines. Inborn errors of their metabolism.
Total: 65 Hours

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Text book:

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. . Principles of Biochemistry Third Edition (Freeman Publishers), New York, 5th edition 2008

Reference Books:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc.,3rd edition 2008.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., (2000). Harper's Biochemistry, Prentice Hall International., 27th edition, 2007.

09BT208 ANALYTICAL BIOCHEMISTRY LAB

Credit: 0:0:2

1. Study of Biochemical Units And Measurements
2.Qualitative Analysis of Carbohydrates
3.Estimation of Glucose by Glucose Oxidase Method
4. Qualitative Analysis of Amino Acids
5. Estimation of Protein By Lowry's Method
6. Estimation of Amino Acid By Ninhydrin Method
7. Assay of Acid Phosphatase enzyme in Potato Extract
8. Estimation of DNA By Burton's Colorimetric Method
9. Estimation of Cholesterol By Zak's Method
10. Estimation of Ascorbic Acid By Titration Method
11. A. Extraction of Total Lipids
    B. Saponification Characteristic of Lipids
12. Dry Ashing of Food Materials And Colorimetric estimation of Phosphorus

09BT209 BIOORGANIC CHEMISTRY

Credit: 4:0:0

Objective

To impart knowledge about biocatalyst, proteins and kinetics of various biochemical reactions

Outcome

At the end of the semester the students will understand various biochemical synthesis, protein kinetics and the mechanism involved in biochemical reactions

Unit – I Concepts in organic chemistry (13)

Stereochemistry- R, S notation, E, Z Isomerism- Mechanism of SN1 and SN2 reactions. Mechanisms of E1 and E2 reactions. Enantiomers, Optical isomers, optical activity and optical rotation-polarimeter.

Unit – II Chemistry of enzymes (13)

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Structure of atom, chemical bonding and its characteristics, Chemical bonding involved in protein structure, Specificity of enzymes. Concept of Free energy and its importance in biology. Chemistry of active oxygen species, free radicals systems.

Unit – III Case studies of enzyme structure and mechanism (13)

Acid base and covalent catalysis**,** Stereochemistry of amino acids, Structure and mechanism of pyruvate dehydrogenase, proteases, ribonucleases, Carboxy peptidase, lysozyme. NAD, Dependent oxidation and reduction reactions,

Unit IV: Hydrolysis in chemical synthesis (13)

Ester hydrolysis, Amide hydrolysis, peptide synthesis, structure and mechanism of FAD THF coenzymes, Application of enzymes in industry and medicine. .

UNIT V : Protein folding kinetics and folding pathways (13)

Structure of proteins- an overview, Basic methods of protein folding – two state kinetics-multistate kinetics-in protein folding**.** Protein folding, its dynamics, stability of proteins and molecular chaperones. NMR, Circular dichorism - Principles, types, components and applications in Biology.

Total: 65 Hours

Text books:

1. Text- H.Dugas , Bioorganic chemistry, Springer Verlag Publishers, 1999.
2. Biochemistry by Mathew , Van Holde, Athern , Pearson Publishers Ltd, New Delhi, 2000.

Reference Books:

1. Fundamental of Biochemistry by J.L. Jain & Sunjay Jain, 6th Edition, 2004.
2. Organic chemistry by Paula yurkaris Bruice, 3rd edition, Pearson P Ltd, New Delhi; 2002.
3. Trevor Palmer, Enzymes, East West Press P Ltd, New Delhi, 2005.
4. Organic Chemistry, Vol:2, 5th edition, I. L. Finar, , Pearson Education, 2007.
5. Text book of Bio-organic Chemistry, H. Dugas. Springer Verlay Publishers, 2002.

09BT210 CELL BIOLOGY

Credit: 4:0:0

Objective:

To know the morphology and functional aspects of cell

Outcome:

The students will be able to understand type of cell, its morphology, signaling, cell culture and transport of various nutrients across the cell wall

Unit – I Structure and Function of the Cell and Its Organelles (13)

Eukaryotic and prokaryotic cells: principles of membrane organization - Micelles, membrane proteins, cytoskeletal proteins, contractile proteins – actin & myosin, extra cellular matrix. Cell division: mitosis & meiosis, cell cycle, molecules that control cell cycle.

Unit – II Transport Across Cell Membranes (13)

Passive & active transport, permeases, sodium potassium pump, Ca^{2+} ATPase pump, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport, symport, antiport, trans-

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membrane potential coupled ATP generation, ion-selective gated channel against neuronal cell membrane, Transport into prokaryotic cells, endocytosis and exocytosis. Entry of virus and toxins into cells.

Unit – III Receptors and Models of Extra Cellular Signalling (13)
Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, quantitation and characterisation of receptors.

Unit – IV Signal Transduction (13)
Signal amplification, different models of signal amplifications, role of cyclic AMP, cyclic GMP and G proteins in signal transduction, biosynthesis of inositol tri phosphates and their role as messengers, calcium ion flux and its role in cell signaling, phosphorylation and regulation of protein kinases in signalling, serine – threonine kinases in signalling.

Unit – V Cell Culture (13)
Techniques for the propagation of eukaryotic and prokaryotic cells. Cell line: generation of cell lines, maintenance of stock cells, characterization of cells, immunochemistry, morphological analysis, techniques in cell culture, explant cultures, primary cultures, contamination, differentiation, three dimensional cultures, role of matrix in cell growth.

Total:65 Hours

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman ***The Cell: A Molecular Approach***, Fourth Edition, ASM Press and Sinauer Associates, Inc.,USA,2007
2. Ian Freshney R, Culture of Animal Cells. Alan R. Liss, Inc., New York. 4nd edition, 2005

Reference Books:

1. Kimball T.W., Cell Biology, Wesley Publishers; 3rd Edition, 2007
2. De Robertis & De Robertis, Cell Biology; 4th Edition, 2006
3. **James D.Watson, Molecular Biology of the Cell. 2005**

09BT211 MICROBIOLOGY

Credit: 4:0:0

Objective

This paper enables the students to identify any microorganisms and its applications.

Outcome

To impart knowledge on classification of microbes and to improve the knowledge on genomic structure of microbes and applications of genetic engineering. This paper deals with various types of classification of microbes. The paper also throws light on multifarious habitats of microbes.

Unit – I Introduction (13)
Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

Unit – II Microbes-Structure and Multiplication (13)

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Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

Unit – III Microbial Nutrition, Growth And Metabolism (13)
Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics, utilization of energy for biosynthesis of important molecules.

Unit – IV Control of Microorganisms (13)
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

Unit – V Industrial and Environmental Microbiology (13)
Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, Vit.B_{12}; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers rhizobia, cyanobacteria, mycorrhizae (AMFungi) and biopesticides; microorganisms and pollution control; biosensors.

Total:65 Hours

Text Book

1. Pelczar MJ, Chan ECS And Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.2007
2. Prasad B.N., "A Text Book of Biotechnology", Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal. 2003.

3. Reference Books:

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 2001.
2. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 2001.
3. Prasad B.N., "Biotechnology in Sustainable Biodiversity and Food Security", Oxford & IBH, New Delhi. 2003.

09BT212 MICROBIOLOGY LAB

Credit: 0:0:2

List of Experiments

1. Microscopy
2. Sterilization and Disinfection
3. Culture Media – Types & Preparation of Agar medium and Nutrient Broth
4. Inoculation of microorganisms
5. Isolation of pure culture by streak plate technique
6. Gram staining
7. Spore stainig
8. Negative stainig
9. Phenol coefficient test
10. Motility test- Hanging drop method and soft agar inoculation

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11. Enumeration of microorganisms from soil
12. Enumeration of microorganisms from water

09BT213 MOLECULAR BIOLOGY

Credit : 4:0:0

Objective

Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation, repair in eukaryotes and prokaryotes and in cancer.

Outcome

The major objective of the paper is to provide knowledge of molecular biology and genetics of prokaryotic and eukaryotic organisms to the students. This paper provides insight on replication, transcription and translation processes in prokaryotes and eukaryotes, various mutations, their repair mechanisms and cancer genetics.

UNIT – I Classical Genetics (13)

Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

UNIT – II DNA Replication (13)

Replication in prokaryotes and eukaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes, DNA repair.

UNIT – III Transcription (13)

Prokaryotic and eukaryotic transcription, features of promoters and enhancers, transcription factors, inhibitors, post-transcriptional modification - RNA splicing, ribozyme. RNA editing.

UNIT – IV Translation (13)

Elucidation of genetic code, process of translation in prokaryotes and eukaryotes, suppressor mutation, post-translational modifications, inhibitors of protein synthesis.

UNIT – V Regulation of Gene Expression (13)

Regulation at various stages of gene expression in eukaryotes and prokaryotes - Lac and trp operons.

Total: 65 Hours

Text Books

1.David Friefelder, Molecular Biology, Narosa Publ. House. 1999
2. Gardner / Simmons / Snustad, Principles of Genetics, Eighth Edition, John Wiley,2005

Reference books

1. Benjamin Lewin, Gene IX, Oxford University Press. 2008

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2. Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM,. Molecular Biology of the Gene. 1987

06BT214 GENETIC ENGINEERING

Credit : 4:0:0

Objective

Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation, r-DNA technology.

Outcome

At the end of the semester the students would have learnt about r-DNA technology, genomic library, PCR and other applications of genetic engineering

UNIT – I Basics of Recombinant DNA Technology (13)

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT – II Creation of Recombinant Molecules (13)

Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT – III Construction of Libraries (13)

Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT – IV Polymerase Chain Reaction (13)

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing- Sanger's method, (Kunkel's Method). Diagnostic importance.

UNIT – V Applications of Recombinant DNA Technology (13)

Cloning in plants, transgenic and knockout animals. Recombinant cytokines and antibodies, vaccines, gene-therapy, stem cell therapy. Invitro fertilization, embryo transfer technology.

Total : 65 hours

Text Book:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.

Reference book:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987
3. Sambrook et al Vol. 1-3, "Molecular Cloning"

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09BT215 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credit: 0:0:2
List of Experiments:

1. Isolation of genomic DNA from plant tissue
2. Isolation of genomic DNA from Micro-organisms
3. Isolation of genomic DNA from animal tissue
4. Isolation of DNA and spectrophotometric analysis
5. Agarose Gel Electrophoresis-genomic DNA
6. Isolation of plasmid DNA from E.coli
7. Restriction enzyme digestion
8. DNA Ligation
9. Molecular weight analysis using Agarose Gel electrophoresis
10. Transformation of cells
11. Competent Cell preparation
12. SDS-PAGE electrophoresis.

09BT216 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credits: 4:0:0
Objective

This course aims to develop the skills of the students in Immunotechnology, antigen antibody response, immunodiagonosis, immunopathology etc.

Outcome

At the end of the course would have learnt about the mechanisms by which a human body interacts with a pathogenic microbe & how it eliminates it. Students, also familiarize themselves with immunopathology and immunotherapy.

Unit I: Outlines of Immunology (13)
Types of Immunity - Innate and acquired immunity, Lymphoid Organs- Primary and Secondary ,

Unit II: Immue Response (13)
Cells of Immune system- Macrophages, T cells, B Cells, NK Cells, Mast cells. MHC and its significance. Subtypes of T Cells and their functions: Cytotoxic T cells, Helper T cells, Suppressor T cells and Regulatory T cells. Cytokines and Cytokines- their biological role; Phagocytosis;Humoral and Cell mediated Immune Response.

Unit III: Antigens, Antibodies and Complements (13)
Antigens- Types; Antigenicity and Immunogenicity; Immunoglobulins – Structure, function and biological properties of different classes of Immunoglobulins; Immunoglobulin Genes; Antigen Antibody Interaction; Complement activation – Classical and alternative pathways.

Unit IV: Immunopathology and Immunologic disorders (15)
Hypersensitivity: Types, mechanisms and disorders; Autoimmunity; Tumour Immunology- Tumour Associated antigens and Tumour Specific Antigens; Transplantation Immunology, Immunodeficiency diseases; Immunotherapy.

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Unit V: Immunity to Infections and Immunotechnology (15)
Immunity to bacteria, virus, fungi and parasites. Active Immunization and Passive Immunization; Monoclonal and Polyclonal Antibody Production; Vaccines; Immunological Techniques – RIA, ELISA and Elispot Assay; Immunocytochemistry, Immunofluorescence.
Text Book:

1 Kuby, J. Immunology. W.H. Freeman and Company, New York. 2002

2 Abul K. Abbas, Andrew K. Lichtman & Jordan S. Pober (Eds.). Cellular and Molecular Immunolgy. 3rd Edn. W.B. Saunders Company, 2001

Reference Books:

1 Ivan Roitt,Essential Immunology, 10th Edn. Blackwell Scientific Publication, , 2002,

2 Weir DM and Stewart, J., Immunology, 10th Edn. Churchill Livingston, New York, 2000.

3 Brudce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D Watson (Eds.) Molecular Biology of the Cell (5th Edn), 2000,.

4 Ivan Roitt, Jonathan Brostoff, David Male (Eds.)., Immunolgy, 5th Edn., Mosby Publication, 2002.

09BT217 CELL BIOLOGY LAB AND IMMUNOLOGY LAB

Credit: 0:0:2

List of Experiments:

1 Study of Microscopy
2 Microscopically Identification of Cells in Permanent Fixed Slides
3 Staining for Various Stages of Mitosis in Allium cepa (Onion)
4 Osmosis and Tonicity Studies Using Red Blood Corpuscles
5 Differentiation of Blood Cells Using Giemsa Staining
6 Separation of Peripheral Blood Mononuclear Cells and Trypan Blue Assay for Live Cell
7 Blood Grouping and Rh typing
8 Preparation of Plasma and Serum
9 Single Radial Immunodiffusion
10 Double Immunodiffusion – Ouchterlony Method
11 Immunoelectrophoresis
12 Counter Current Immunoelectrophoresis
13 Rocket Immunoelectrophoresis – Laurell method
14 Immunodiagnosis of Typhoid fever – Widal Test
15 Enzyme Linked Immunosorbent Assay

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09BT218 BIOPROCESS PRINCIPLES

Credit : 4:0:0

Objective

To develop skills of the students in the area of Bio process Technology with emphasis on Bioprocess principles. This is a pre-requisite for courses on Bioprocess Engineering offered in the subsequent semesters.

Outcome

At the end of the course, the students would have learnt about fermentation processes, Metabolic stoichiometry, Energetics, Kinetics of microbial growth etc. This will serve as an effective course to understand certain specialized electives in Bioprocess related fields.

UNIT – I Overview of Fermentation Processes (13)

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT – II Raw Materials and Media Design for Fermentation Process (13)

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

UNIT – III Sterilization Kinetics (13)

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of depth filters, design of sterilization equipment - batch and continuous.

UNIT – IV Metabolic Stoichiometry and Energetics (13)

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures,

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UNIT – V Kinetics of Microbial Growth and Product Formation (13)

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

Total : 65 hours

Text books:

1 Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts – Second Edition Prentice Hall of India Pvt. Ltd., 2002
2 Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 1999.

Reference Books:

1 Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.), 1986.
2 Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications,2005.
3 Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc,2007.

09BT219 BIOPROCESS LAB

Credit : 0:0:2

Title of the Experiments:

1. Culturing of Different Types of Microorganism
2. Estimation of Biomass Production
3. Effect of Substrate Concentration on Growth Of E-coli
4. Effect of pH on Enzyme Activity
5. Effect of Temperature on Enzyme Activity
6. Immobilization of ∞ - Amylase Enzyme
7. Components of Fermentor
8. Determination of Volumetric Mass Transfer Coefficient
9. Enzyme Assay- Starch Plate Assay
10. Quantitative Enzyme Assay
11. Production of Wine
12. Production of Amylase From Bacillus subtilis and Assaying for its Activity

09BT220 ENZYME ENGINEERING AND TECHNOLOGY

Credits: 4:0:0

Objective

To develop skills of the students in the area of Enzyme Engineering with emphasis on Bioreactor operation and design.

Outcome

At the end of the course, the students would have learnt about classification of enzymes, immobilization, extraction and purification of enzymes and biosensors.

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UNIT I INTRODUCTION AND APPLICATION OF ENZYMES (13)

Classification of enzyme; Types of enzymes-Constitutive enzyme, induced enzymes, Intracellular and Extracellular enzymes; Application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications.

UNIT II MECHANISMS AND KINETICS OF ENZYME ACTION (13)

Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action , kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multi substrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.

UNIT III PURIFICATION AND CHARACTERIZATION (13)

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

UNIT IV ENZYME IMMOBILIZATION (13)

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme system

UNIT – V ENZYME BIOSENSORS (13)

Types of Biosensors; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

Total : 65 hours

Text Books:

1. Enzymes by Palmer Horwood Publishing Series. 2001
2. Fundamentals of Enzymology by Price and Stevens Oxford University Press. 2002

Reference Books:

1. Biocatalysts and enzyme technology**,** Klaus Buchholz, Volker Kasche, Uwe Theo Bornscheuer ,Published by Wiley-VCH, 2005
2.Biotechnology for the Future**,** Jens Høiriis Nielsen, Sabine Arnold, Contributor Jens Høiriis Nielsen,Published by Springer, 2005
3.Enzymes in Industry: Production and Applications**,**Wolfgang Aehle Contributor Wolfgang Aehle,Edition: 2,Published by Wiley-VCH, 2004
4.Text ***book 'Enzyme Technology,*** Martin Chaplin and Christopher Bucke, Cambridge University Press, Dec 2004

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09BT221 BIOPROCESS ENGINEERING

Credits: 4:0:0

Objective

To develop skills of the students in the area of Bio process Engineering with emphasis on Bioreactor operation and design.

Outcome

At the end of the course, the students would have learnt about Bioreactor operation and design, scale-up, modeling and simulation . This will serve as an effective course to understand certain specialized electives in Bioprocess related fields

UNIT I DESIGN AND ANALYSIS OF BIOREACTORS (13)

Design and operation of novel bioreactors-Air-lift loop reactors; Fluidized bed-bioreactors; packed bed reactor, Bubble column reactor, RTD and stability analysis of bioreactors

UNIT II BIOREACTOR SCALE-UP (13)

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed

UNIT III MONITORING OF BIOPROCESSES (13)

On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry ; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes

UNIT IV MODERN BIOTECHNOLOGICAL PROCESSES (13)

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures

UNIT V MODELLING AND SIMULATION OF BIOPROCESSES (13)

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

Total : 65 hours

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Text Books:

1. Michael Shuler, Fikret Kargi, "Bioprocess Engineering Principles",Second edition, Prentice Hall,2002

2. P.Stanbury, A.Whitaker,SJ Hall "Principles of fermentation technology",Second edition, Elsvier Pergamon Press,1999

Reference Books:

1. Pauline Doran,"Bioprocess Engineering Principles", Academic Press,1995
2. Elmar Heinzle, Arno P.Biwer, "Development of Sustainable Bioprocess: Modelling and Assessment", Wiley, 2007.
3. Bjorn K.Lyderson, Nancy Ade'lia and Kim Nelson,"Bioprocess engineering *(handcover)",*Wiley Interscience,1994

09BT222 DOWNSTREAM PROCESSING

Credit : 4:0:0

Objective

To develop skills of the students in the area of Downstream processing with emphasis on purification of products.

Outcome

At the end of the course, the students would have learnt about various methods of separation and purification of bioproducts.

UNIT – I Downstream Processing (13)

Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts

UNIT – II Physical Methods of Separation (13)

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT – III Isolation of Products (13)

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT – IV Product Purification (13)

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

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UNIT – V Final Product Formulation and Finishing Operations (13)

Crystallization, drying and lyophilization in final product formulation.

Total : 65 hours

Text book

1.. Bioseperations: Principles and Techniques, B. Sivasankar,Published by PHI Learning Pvt. Ltd., 2006

2.Bioseparation Technology,Mishra Neeraj,CRC Press,2008

Reference Books:

1.Bioseparations Science and Engineering ,Day, Trevor G, and Harrison, Roger G, and Rudge, Scott R, Publisher: Oxford University Press, USA, 2002

2..Handbook of Bioseparations**,**Satinder Ahuja,Published by Academic Press, 2000

3..HPLC of Biological Macromolecules,Karen M. Gooding, Fred E. Regnier, Contributor Karen M. Gooding, Fred E. Regnier,Published by CRC Press, 2002

4.. Isolation and Purification of Proteins,Rajni Hatti-Kaul, Bo Mattiasson,Published by CRC Press, 2003

5.. A Century of Separation Science, Haleem J. Issaq,Published by CRC Press, 2002

09BT223 DOWNSTREAM PROCESSING LAB

Credit : 0:0:2

List of Experiments:

1. Batch Sedimentation
2. Cell disruption by Homogenizer
3. Batch Distillation
4. Adsorption
5. Protein purification by salting –out method (ammonium sulphate)
6. Solid recovery by centrifugation
7. Liquid – liquid extraction
8. Plate and frame filter press
9. Drying of solids by light source
10. Lyophilization (Freeze drying of culture)
11. Flocculation
12. High-performance liquid chromatography (HPLC)

09BT224 METABOLIC ENGINEERING

Credit : 4:0:0

Objectives

To develop skills of the students in the area of metabolic engineering to alter the metabolic pathway to enhance the product yield.

Outcome

At the end of the course, the students would have learnt about various methods synthesis of primary and secondary metabolites and bioconversion.

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UNIT – I Introduction (13)

Jacob Monod model for gene expression regulation-Lac operon, catabolite regulation- glucose effect- cAMP deficiency. Regulation of RNA synthesis by amino acid. Feedback regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feedback regulation, cumulative feedback regulation, permeability control: passive diffusion, active transport, group transportation.

UNIT – II Synthesis Of Primary Metabolites (13)

Alteration of feed back regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites.

UNIT – III Biosynthesis Of Secondary Metabolites (13)

producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

UNIT - IV Bioconversions (13)

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

UNIT - V Regulation Of Enzyme Production *(13)*

Strain selection, improving fermentation, recognising growth cycle peak, induction, feed- back repression, catabolite repression, mutants resistant to repression, gene dosage.

Total : 65 hours

Text books

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

Reference Books:

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., " Fermentation And Enzyme Technology ", John Wiley And Sons., 1980.
2. Zubay G., " Biochemistry ", Macmillan Publishers, 1989.

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09BT225 APPLIED PLANT AND ANIMAL BIOTECHNOLOGY

Credit: 4:0:0
Objective

To develop skills of the students in the area of plant and animal biotechnology and its applications.

Outcome

At the end of the course, the students would have learnt about various Plant and animal tissue culture methods and its applications.

UNIT –I Introduction to Plant Biotechnology (13)

In-vitro Methods in plant tissue culture, Aseptic Techniques, Nutrient media, and use of growth regulators, Organ Culture – Anther, Embryo and Endosperm culture and their applications Organogenesis and Somatic Embryogenesis – Techniques and applications.

UNIT – II Plant Tissue Culture (19)

Methods in Biotechnology Protoplast Culture – Isolation, regeneration and viability test, somatic hybridization, methods of protoplast fusion –chemical and electro fusion, practical application of somatic hybridization and cybridization.
Plant cell cultures for the production of useful chemicals : pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds. Role of tissue culture in agriculture, horticulture and forestry. Applications of transgenic plants. Edible Vaccines from plants. Herbicide resistance and stress tolerance in plants, Bioinsecticdes and Biofertilizers .

UNIT – III Plant Genetic Engineering (13)

In-Vitro fertilization – Ovary and Ovule culture. Clonal Propogation of elite species (Micro Propagation).Somaclonal Variation and their significance. In-Vitro production of secondary metabolites – Techniques and significance. Transgenic plants Technique of transformation – Agrobacterium mediated and physical Methods. Electroporation and Biolistics(Microprojectile bombardment)

UNIT – IV Animal Cell Culture and Gene Cloning (10)

Culture Media for growth of animal cells 1. Natural media –Plasma Clot, biological fluids tissue extract, Importance of Serum in media 2. Chemically defined media a) Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. b) Secondary Culture – transformation and transfection of animal cell lines, maintenance of continuous cell lines, HAT selection, Selectable Makers etc.

UNIT – V Animal Genetic Engineering *(10)*

In vitro fertilization and embryo transfer. Production of recombinant Vaccines and hormones Interleukines, Stem cell Culture and applications .Techniques for gene transfer in animals,

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xenotransplantation, Cytotoxicity, LD50, LC50, Dermal, Mucous, Eye, Reproduction, Neurobehaviour, Carcinogenicity and Mutagenicity.

Total : 65 hours

Text Books

1. S.Ignacimuthu.S.J.. Plant Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. 2006
2. Dubey, R.C.. Text Book of Biotechnology. S. Chand & Co. 2006

Reference Books:

1. Satler et al Plant Biotechnology. Oxford University press,2008
2. Bains Biotechnology from Ato Z. Oxford University press, 2005
3. Gupta P.K.. Elements of Biotechnology. Rastogi Publications, Meerut. 2006
4. Walker and Rapley, Molecular Biology and Biotechnology, Panima.2003
5. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press, 2000

09BT226 BIOETHICS, IPR AND BIOSAFETY

Credits: 4:0:0

Objective

To impart knowledge on moral issues, IPR and biosafety.

Outcome:

At the end of the course, the students would have learnt about

- Engineering Ethics and Human Values.
- Moral and Social Values and Loyalty
- The rights of others

Unit-I Engineering ethics ***(13)***

Senses of "Engineering Ethics"' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories

Unit-II Environmental Aspects Of Biotech Applications ***(13)***

Use of genetically modified organisms and their release in environment Special procedures for r-DNA based product production. Identification of directions for yield effect in agriculture, aquaculture etc, Bioremediation.

Unit-III Intellectual Property Rights ***(13)***

TRIPS, International conventions patents and methods application of patents, Legal implications, Biodiversity and farmers rights. Beneficial applications and development of research focus to the need of the poor.

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Unit-IV Global Issues ***(13)***

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline), Biosafety.

Unit-V The Legal And Socioeconomic Impacts Of Biotechnology (13)

Public education of the process of the processes of biotechnology involved in generating new forms of life for informed decision making Biosafety regulation and National and international guidelines r-DNA guidelines, Experimental protocol approvals, levels of containment

Total : 65 hours

Text Books:

1. Sasson A, "Biotechnologies and Development ", UNESCO Publications, 1988.
2. Sasson A, " Biotechnologies in developing countries present and future ", UNESCO Publishers, 1993.

Reference Books:

S.Dhinesh Babu, "Professional Ethics and Human Values", Lakshmi Publications Pvt. Ltd.2007.

09BT227 BASICS OF BIOINFORMATICS

Credit : 4:0:0

Objective:

To impart knowledge on basic techniques of Bioinformatics

Outcome:

At the end of the course, the students would have learnt about

- Sequencing Alignment and Dynamic Programming
- Sequence Databases
- Evolutionary Trees and Phylogeny

Unit I Introduction to Bioinformatics **(13)**

Scope of Bioinformatics – Elementary commands and Protocols, ftp, telnet, http. Printer on information theory. Databanks – nucleotide databanks – Genbank, NCBI, EMBL, DDBJ – protein databanks – sequence databanks – PIR, SWISSPROT, TrEMBL _ structural databases – PDB, SCOP, CATH.

UNIT II : Sequencing Alignment and Dynamic Programming (13)

Introduction – Strings – Edit distance two strings – string similarity local alignment -gaps – Parametric sequence alignments – suboptimal alignments – multiple alignment – common multiple alignment methods.

Unit III : Sequence Databases and Their Uses **(13)**

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Introduction to databases – database search – Algorithms issues in database search – sequence database search – FASTA – BLAST – Amino acid substitution matrices PAM and BLOSUM. GCG Sequence Analysis(Basic concepts only)

UNIT IV : Evolutionary Trees and Phylogeny (13)

Ultrasonic trees – parsimony – Ultrametric problem – Perfect phylogeny – Phylogenetic alignment – connection between multiple alignment and tree construction.

UNIT V : Special Topics in Bioinformatics (13)

DNA Mapping and sequencing – Map alignment – Large scale sequencing and alignment – Shotgun – DNA sequencing – Sequence assembly – Gene predictions – Molecular predictions with DNA strings.

Total : 65 hours

Text Book

1. Dan Gusfield, Algorithms On Strings Trees And Sequences, Cambridge University Press, 1997
2. T.K.Attwood and D.Parry Smith, Introduction to Bioinformatics,Pearson Education,2001.

Reference Books

1. Lesk, Introduction to Bioinformatics, Oxford university press ,2002.
2. R.Durbin,R.eddy,K.Anders and M.Graeme, Biological Sequence analysis,Probabilistic models of proteins and Nucliec acids,Cambridge University Press,1997.

09BT228 BIOINFORMATICS LAB

Credit : 0:0:2

List of Experiments:

1. NCBI - Viral and bacterial genome analysis
2. BLAST – Similar DNA sequences search
3. EMBL – Nucleotide sequence database
4. SWISSPROT/TREMBL – Protein sequence database
5. Analysis of Protein sequence using PIR database
6. Analysis of structural features of proteins using protein data bank and SWISS PDB viewer
7. Eukaryotic gene prediction
8. Identification of disease gene
9. Protein sequence analysis tools
10. Multiple sequence alignment and phylogenetic trees

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09BT229 CHEMICAL THERMODYNAMICS AND BIOTHERMODYNAMICS

Credit: 4:0:0

Objective

The course aims at making the students understand the fundamental principles and concepts of chemical and biothermodynamics.

Outcome

The students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose, aim advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT – I Thermodynamic Properties of Fluids (13)

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT – II Solution Thermodynamics (13)

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT – III Phase and Chemical Reaction Equilibria (13)

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria. Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT – IV Thermodynamic Analysis of Processes (13)

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

UNIT – V Biochemical Thermodynamics (13)

Energetics of metabolic pathways energy coupling (ATP and NADH), stochiometric and energetic analysis of cell growth and product formation-elemental balances, degree of reduction concepts-available –electron balance, yield coefficients, oxygen consumption and heat evolution in aerobic cultures, thermodynamics efficiency of growth.

Total: 65 Hours

Text Books

1. Narayanan K.V. A Text Book Of Chemical Engineering Thermodynamics, Prentice Hall India, 2001.

Reference books

1. Sandler S.I. Chemical And Engineering Thermodynamics, John Wiley,1989.

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2. Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics. 6th Edition. McGraw-Hill, 2001.
3. Royels, JA, Kinetics and Energetics in Biotechnology, Elseviers, 1983

09BT230 BIO REACTION ENGINEERING

Credit : 4:0:0

Objective

This deal with the study of kinetics of chemical and bio chemical process and exposes the design of several types of reactions.

Outcome

To expose the fundamental of

- Kinetics of homogeneous reaction in batch reactors
- Design of ideal reactor
- Design principles in non isothermal reactions
- Non ideal flow reactor modules
- Design equation in biochemical reactors

Unit-1 Homogeneous Reactions (13)

Introduction, classification of chemical reactions, definition of reaction rate, variable affecting the rate of reaction, rate expression, molecularity & order of reaction, rate constants, temperature dependent term of a rate equation [Arrhenius law, Collision Theory], Homogeneous reactions, Batch reactor data / Kinetic data – Constant – volume reactor, variable – volume reactor [Integral method, Differential method], Half life time.

Unit-2 Ideal reactors (13)

Types of reactor – Batch, CSTR, PFR, reactor design, Multiple reactor.
CSTR, PFR connected in series & parallel, mixed reactors.

Unit-3 Non – Ideal reactors (13)

Non-ideal flow introduction & various models [Compartment model, Dispersion model, Tank in series model], RTD studies.

Unit-4 Multiple reactions (13)

Irreversible reaction & reversible reactions, series & parallel reactions, first-order followed by zero-order reaction, zero-order followed by first-order reaction, Denbigh reactions-Batch, CSTR and PFR.

Unit-5 Biochemical Reactions (13)

Biochemical Reactions - Cell growth - Rate equations - Stoichiometry - Mass Balance - Design Equations.

Total: 65 Hours

Text Books

1. Octave Levenspiel-"Chemical Reaction Engineering", Third edition – John Willey, 1999.

Karunya University

2. Bailey & ollis – "Biochemical Engineering Fundamentals", second edition – McGraw Hill, 1986.

Reference Books

1. Scott Fogler. H – " Elements of Chemical Reaction Engineering" – second edition – Prentice Hall of India Pvt. Ltd., 1995.
2. Charles D. Holland – "Fundamentals of chemical Reaction Engineering" Second edition – John willey & sons, 1990.
3. Smith J. M. – "Chemical Engineering Kinetics" – Second edition – McGraw Hill, 1981.
4. Shule & Karg – "Bioprocess Engineering" – Prentice Hall, 1992.

09BT231 ADVANCED BIOPROCESS LAB

Credits : 0:0:2

List of Experiments:

1. Enzyme Kinetics
2. Enzyme Production by SMF
3. Enzyme Production by SSF
4. Amino Acid Production
5. Medium Optimization by Plackett-Burman Method
6. Determination of kLa by Dynamic Gassing Out Method
7. Growth Kinetics of E.coli in Batch Reactor
8. Design Equation of Batch Reactor
9. Design Equation of CSTR
10. Design Equation of PFR
11. Thermal Death Kinetics
12. Immobilization of Cells or Enzymes by Encapsulation

09BT232 PROTEIN ENGINEERING

Credits: 4:0:0

Objective

To develop skills of students in chemical bonds and their interactivity, protein architecture and its influence on protein function. Application of knowledge of protein in biotechnology.

Outcome

Upon successful completion of this course, the student should be well versed in the following: Chemical bonds and their influence in protein structure formation. Comprehensive knowledge of 3-D structure in relation to its functions. Appreciate the application of this knowledge in protein engineering.

Karunya University

UNIT I BONDS AND ENERGIES IN PROTEIN MAKEUP (13)

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II AMINO ACIDS AND THEIR CHARACTERISTICS (13)

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

UNIT III PROTEIN ARCHITECTURE (13)

Primary structure, Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, Tertiary structure: Domains, folding, denaturation and renaturation, Quaternary structure: Modular nature, formation of complexes.

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP (13)

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes : Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase

UNIT V METHODS OF PROTEIN ENGINEERING *(13)*

Methods of Proteins engineering, Immunotoxins, Drug Designing

Total : 65 hours

Text Books:

1. Moody PCE and Wilkinson AJ "Protein Engineering" IRL Press, Oxford,1990
2. Branden C.Tooze, "Introduction to protein structure", Garland,1993.

Reference books:

1. Creighton TE, "Proteins" Freeman WH Second edition,1993
2. Paul R.Carey,"Protein Engineering and Design",Academic Press,1996
3. Lutz, Stefan/Bornschever, "Protein Engineering Handbook",Wiley VCH,2009
4. Robert Murray, Daryl Granner,"Harpers's Illustrated Biochemistry" 26th Edition, International Edition,2003

09BT233 PLANT BIOTECHNOLOGY

Credits: 4:0:0

Objectives

To develop skills of the students in the area of plant biotechnology and its applications.

Karunya University

Outcome

At the end of the course, the students would have learnt about various Plant tissue culture methods and its applications

Unit 1: Cell and Tissue Culture (13)

Definition and need; Types of Methods in plant Biotechnology; Cell and Tissue Culture; Micro propagation; Callus Culture; Somatic Embryogenesis; Hairy Root Culture; Culture Medias.

Unit 2: Plant Genetic Engineering Tools, Plant Vectors and plant Viruses (13)

Vectors and Genetic Engineering; Agro bacterium mediated gene transfer and cloning; Agro bacterium types; Plant viruses and Genetic Engineered viruses as a tool of deliver foreign DNA; major plant viruses, Camv, TMV, BBTV, Gemim viruses etc.

Unit 3: Application of Plant Biotechnology (13)

Hairy Root Cultures and Secondary Metabolite production; Plant as Bioreactors- edible Vaccines; Germplasm conservation; Gene Banks; Crop improvement; legume symbiosis, N_2 Fixation; Regulation of NIF and NOD Genes.

Unit 4: Molecular Aspects of Disease Susceptibility and Resistance (13)

Transposable elements, factors influencing disease resistance and susceptibility RFLP

Unit 5: Transgenics *(13)*

Stress tolerance-Biotic and a biotic temperature, salinity, drought etc; Pests and insects resistance- viral resistance- development of disease resistance plants by introducing Bacillus thuringiensis genes.

Total : 65 hours

Text Books

1. H.S. Chawala, Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 2002.
2. S. Ignacimuthu S.J. Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2004.

Reference Books

1. Adrian Slater, Nigel Scott, and Mark Fowler. Plant Biotechnology. The genetic manipulation of plants. Oxford University Press 2008.
2. Mantal SH, Mathew JA., Mickee RA., Principles of Plant Biotechnology. An Introduction to Genetic Engineering in Plants, Blackwell Scientific Publication, 2000.

Karunya University

3. Dodds JH. Plant Genetic Engineering. Cambridge University Press. 2001.

09BT234 ANIMAL BIOTECHNOLOGY

Credit : 4:0:0

Objective

To develop skills of the students in the area of animal biotechnology and its applications.

Outcome

At the end of the course, the students would have learnt about various animal tissue culture methods, animal diseases, therapy, micromanipulation, transgenic animals and its applications

UNIT I Animal Cell Culture (13)

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures- suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II Animal Diseases And Their Diagnosis (13)

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP.

UNIT III Therapy Of Animal Diseases (13)

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV Micromanipulation Of Embryos (13)

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V Transgenic Animals (13)

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

Total : 65 hours

Karunya University

Text Books

1. Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2. Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce. The Biological Basis of Cancer. Cambridge University Press, New York 2003.

Reference Books:

1. Macdonald F and Ford CHJ. Molecular Biology of Cancer. Bios Scientific publishers,2002.
2. Maly B.W.J, "Virology A Practical Approach", IRLl Press, Oxford, 2001.
3. Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 2002
4. An Introduction to Cellular and Molecular Biology of Cancer, J Oxford Medical Publications, 2003.

09BT235 CANCER BIOLOGY

Credit : 4:0:0

Objectives

To develop skills of the students in the area of cancer biology

Outcome

At the end of the course, the students would have learnt about fundamentals of cancer biology, carcinogenesis, metastasis and cancer therapy.

UNIT I : Fundamentals Of Cancer Biology (13)

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II : Principles Of Carcinogenesis (13)

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III : Principles Of Molecular Cell Biology Of Cancer (13)

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

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UNIT IV : Principles Of Cancer Metastasis (13)

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V :New Molecules For Cancer Therapy *(13)*

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

Total : 65 hours

Text Books

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book of Animal Biotechnology. Akshara Printers, 2000.

Reference Books:

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press, 2000.
2. Dubey, R.C. Text Book of Biotechnology. S. Chand & Co. 2004.
3. Gupta P.K. Elements of Biotechnology. Rastogi Publications, Meerut. 2004.
4. Kumar H.D. A Text book of Biotechnology. East West Affiliated Press. 2003.

09BT236 BIOPROCESS ECONOMICS AND PLANT DESIGN

Credit : 4:0:0

Objective

To know about the various Bioprocess and the ways to enhance the production of industrially important bioproducts

Outcome

At the end of the semester the students will be able to analyze various bioprocess, reactor design and control .

UNIT I : Process Economics And Business Organizations (13)

Definition of Process, Process Economics, Importance of various M-inputs-Globalization concept-Competition by Dumping-It's effect on Plant size-Status of India- Project profile concept-details; Structure and Types of Organizations

UNIT II : Project Design And Development (13)

Choosing a Project, Market Survey, Importance of Techno-Economic-Feasibility Studies, Sourcing of Processes, Process alternatives, Fixing most economic processes, Technology-Scanning, Plant Location Principles, Plant Lay out, Process Flow sheets, Preparation of Budgetory investment and production costs.

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UNIT III : Cost Estimation, Profitability And Accounting (13)

Capital investment, Concept of time-Value of money, Source Sink concept of Profitability, Capital Costs, Depreciation, Estimation of Capital costs, Manufacturing Costs, Working Capital; Profitablity Standards, Project profitability evaluation, Alternative investments and Replacements; Annual reports, Balance Sheets, Performance Analysis.

UNIT IV : Process Optimization Techniques (13)

Optimum design-Design Strategy, Economic-Balance, Design of Variables.

UNIT V : Quality And Quality Control *(13)*

Current good manufacturing practices. Concepts of Quality Control in 20th century; Elements of quality control envisaged by BIS since 1947; Emergence of Statistical Process Control (SPC), Simple SPC concept details, Fundamental Concepts of ISO 9000 Quality System and the various requirements for ISO certification. Six sigma concept in Quality control

Total : 65 hours

Text Books:

1. Peter MS ,Klaus D, "Plant Design and Economics for Chemical Engineers,Mc Graw Hill,International Edition,Chemical Engineering Series,1991
2. Senapathy,"Textbook of Principles of Management and Industrial Psychology, Lakshmi Publications,2001

Reference Books:

1. Rudd Watson,"Stratergy for Process Engineering",Wiley Publications,1987

09BT237 APPLIED ENVIRONMENTAL BIOTECHNOLOGY

Credit : 4:0:0

Objective:

To develop skills of students in various biological phenomena, which can be exploited to save environment from eventual deterioration. To know about water treatment and sludge treatment methods. To understand the process of bioremediation

Outcome:

At the end of the course, the students would have learnt about the advantages of deriving fuel through fermentation rather than from fossil sources. Describe the part played by bacteria in the process of decay and recycling of carbon and nitrogen, integrate prior knowledge of how biophysical systems work so as to better understand the constraints and opportunities for natural-resource and environmental management.

Unit I : Introduction (13)

Origin and Definition of old and new biotechnology, Biotechnology a multidisciplinary growing tree, scope and importance of Biotechnology in India. Environmental Pollution - soil, water air, oil and heavy metal pollution, Types and causes and its effects on environment. Microbial flora of soils .

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Unit II : Industrial waste water management (13)

Aerobic and anaerobic waste water treatment, sewage disposal and treatment – physical and biological treatment, effluent treatment – primary and secondary treatment. Biological nitrogen and phosphate removal - waste water treatment in diary, distillery, tannery, sugar and industry pulp.

Unit III : Biomass (13)

Types and composition of biomass, waste as renewable source of energy, methods of energy production, energy and fuel using microorganisms, conversion of methane to synthetic gas, cellulose as a source of energy, conservation of energy.

Unit IV : Bioremediation and biodegradation (13)

Pseudomonas for bioremediation, types and reactions of bioremediation, biodegradation of hydrocarbons and pesticides, microbes in leaching of metals – leaching of copper and uranium, Control of air pollution, control devices for gaseous pollutants, volatile organic pollutants.

Unit V : Biodiversity (13)

Biodiversity at global level, species diversity.Biodiversity and its conservation – insitu and exsitu conservation. Loss of biodiversity and its causes. Intellectual Property Rights (IPR) and patenting – patents for higher plants and animals

Total : 65 hours

Text Books

1. R. C. Dubey A Textbook of Biotechnology, , S.Chand publications, 4th edition,2008
2. Foster C.F. John ware D.A. Environmental Biotechnology, Ellis, Honwood Ltd. 2007

Reference Books:

1.Karnely D. Chakrabarty K. Ovnen G.S. Biotechnology and Biodegradation, Advances in Applied Biotechnology series, Vol. Gulf Publications Co. London 2007.
2. M. Moo-Young, W.A. Anderson and A.M. Chakrabarty.Environmental Biotechnology : Principles and Applications,New Delhi, Springer, 2007

09BT238 INTRODUCTORY GENOMICS AND PROTEOMICS

Credit : 4:0:0

Objective

To develop skills of the students in the area of genomics and proteomics.

Outcome

At the end of the course, the student would learnt about various aspects of genomics, proteomics and its application This will be very useful for the student to undertake research /project work inbioinformatics.

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Unit I: (13)
Overview –Variation and regulation in Prokaryotic & Eukaryotic genome expression profile– Brief outlook of various genome projects and their outcome. Nucleotide & protein sequencing methods – Chemical, enzymatic, high through put method – Automated sequencing methods

Unit II: (13)
Various Approaches in sequencing genome – shotgun, directed short gun & Clone contig approach – Primer walking, chromosome walking, chromosome jumping, Contig assembly, Genome Marking and mapping techniques

Unit III: (13)
Mapping and sequence assembly – genetic marker– Physical Marker –, Radiation hybrids – Sequence markers. Expression analysis – micro array approach, Human Genome Project - Transcriptome– structural & functional Genomics – comparative & population genomics- Pharmacogenomics – Phylogenetics.

Unit IV: (13)
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 .

Unit V: (13)
Proteome databases: protein sequence database, SWISS-PROT, TrEMBL, specialized protein sequence databases, PROSITE, BLOCKS, 2-D PAGE databases, PDB, genomic databases, OMIM, Metabolic databases, Some specific metabolic databases

Total: 65 hours

Text Book:

1. T.A Brown , Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002

Reference Book:

1. Pennington, Proteomics from Protein Sequence to Function, 2nd edition, Viva Books Ltd, 2002
2. David W Mount, Bioinformatics: sequence and genome analysis, 2nd edition, CBS publishers, 2004

09BT239 BIO PHARMACEUTICAL TECHNOLOGY

Credit: 4:0:0

Objective

To develop skills of students in the area of biopharmaceutical technology.

Outcome

At the end of this course, the students would have learnt about pharmacokinetics and pharmacodynamics principles, important unit operations, biopharmaceutical products, quality control and quality assurance of pharma products etc.

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UNIT I Basic principles of Pharmacokinetics and Pharmacodynamics (13)
Introduction - Development of Drugs and Pharmaceutical Industry. Drug Metabolism and Pharmacokinetics - Drug Metabolism – Physico-Chemical Principles –Pharmacodynamics – Action of drugs on human bodies.

UNIT II Preparation of Solid Dosage Forms (13)
Manufacturing Principles - Compressed tablets – wet granulation – Dry granulation – Direct compression – Tablet presses formulation – Coating – Pills – Capsules sustained action dosage forms. Quality control tests for tablets and capsules. Packaging of solid dosage forms.

UNIT III Preparation Of Semisolid And Liquid Dosage Forms (13)
Manufacturing Principles - Parental solutions – Oral liquids – injections – Ointments. Quality control tests for semisolid and liquid dosage forms. Packaging of semisolid and liquid dosage forms

UNIT IV Pharmaceutical Products (13)
Pharmaceutical Products - Vitamins – Cold remedies – Laxatives –Analgesics –External Antiseptics – Antacids. Antibiotics – Biologicals – Hormones. Recent advances in the manufacture of drugs using r-DNA technology.

UNIT V Clinical Trails And Regulations, Bioinformatics (13)
Clinical Trials & Regulations - Clinical Trials – Design, double blind studies, placebo effects. FDA regulations (General) and Indian Drug regulations- highlight. Good manufacturing practice. The Use of Molecular Modelling, Chemoinformatics, Cerius 2 and QSAR to Discover and Design New Molecules.

Total: 65 hours

Text books

1. DM Brahmankar, Sunil B Jaiswal , Biopharmaceutics and Pharmacokinetics-A Treatise, Vallabh prakashan,2005 .
2. Ansel, H., Allen, L., Popovich, N.Pharmaceutical Dosage Forms and Drug Delivery Systems, Williams & Wilkins. 1999.

Reference books

1. Remington's Science and Practice of Pharmacy, lippin cott williams & wilkins publishers, 2005.,
2. Goodman & Gilman's The pharmacological basis of therapeutics by Joel Griffith Hardman ,Lee E. Limbird, Alfred G. Gilman.2005
3. A.R.Leach, Molecular Modelling Principles and Application, Longman, 1996.
4. Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.
5. Tripathi KD, Essential of Medical pharmacology by, 2003

09BT240 NANOBIOTECHNOLOGY

Credit: 4:0:0

Objective

To develop skills of the students in the field of nanobiotechnology and its applications in various fields.

Karunya University

Outcome

At the end of the course, the students would have learnt about Automobile, Electronics, Nanobiotechnology, Materials, Medicine, Dental care, Nanocomputers, Power storage, Nanotechnology products Latest Developments in Nanotechnology etc. This will serve as an effective course to understand Socio-economic issues of nanobiotechnology.

UNIT 1 **(13)**

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Visions and Objective of Nanotechnology, Nanotechnology in Different, Fields: Automobile, Electronics, Nanobiotechnology, Materials, Medicine, Dental care, Nanocomputers.

UNIT 2 **(13)**

Nano Particles :Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNIT 3 **(13)**

Application: Nanomedicine, Nanobiocensor and Nanofludics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNIT 4 **(13)**

Nanobiotechnology: Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nanocarbon tubules. Nanosurgical devices.

UNIT 5 **(13)**

Ethical Issues in Nanotechnology: Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Non-medical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic Challenges

Total:65Hours

Text Books

1. Ratner M, Ratner D – "Nanotechnology: A Gentle Introduction to the next Big idea", Prentice Hall, 2003.
2. H. S. Nalwa – "Encyclopedia of Nanoscience & Nanotechnology" McGraw Hill, 2004.

Reference Books

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1. CNR Rao – " The chemistry of Nanomaterials: Synthesis, Properties & Application" Springer 2006
2. Viola Vogel –" Nanomedicine & Nanotechnology", John Willey & Sons Ltd., 2008.
3. Goodsell – " Nanobiotechnology", John Willey & Sons Ltd., Third edition, 2004.
4. Ralph S. Greco, - "Nanoscale Technology in Bilogical systems", CRC Press, 2005

09BT241 ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB

Credit: 2:0:0

List of Experiments

1. UV spectra of Nucleic Acids
2. Chromatography analysis using TLC
3. Finding the Concentration of Sodium and Calcium using Flamephotometer
4. PCR
5. Western Blotting
6. HPLC
7. GC
8. Lyophilizer
9. Agarose gel Electrophoresis
10. Nephlometer
11. X-ray Diffraction instrument
12. Paper Chromatography
    Differential Scanning Colorimetry

09BT242 INTRODUCTORY BIOTECHNOLOGY

Credit 3:0:0

Objective

To develop skills of the students in the field of biotechnology and its applications in various fields.

Outcome

At the end of the course, the students would have learnt about the cloning, transgenics, gene bank, finger printing, molecular characterization etc. This will serve as an effective course to understand Socio-economic issues of Biotechnology

UNIT – I

Definition – Scope – Biotechnology in India – Applications of biotechnology: disputed parenthood, criminology & taxonomy.

UNIT – II

Principles and Methods of gene cloning – application.Gene cloning vectors – Plasmids PBR 322, PUC 8 – cosmids PLFR 5, PJB 8 – SV40, BPV – their salient features and uses – enzymes in gene cloning – transfection - amplification – expression vectors.

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UNIT – III
Transgenic plants – herbicide, insecticide and virus resistant plants – Transgenic animals mice, cattle, fishes and poultry. Socio-economic issues of Biotechnology.

UNIT – IV
Integrated nutrient supply and IPM system, Biological nitrogen fixation – basic requirements – symbiotic and nonsymbiotic nitrogen fixation – production and application of rhizobium as a biofertilizer – production and application of ethanol as bio--fuel, Phosphorous, Potash, Sulphur – Solubilization.

UNIT – V
Gene Banks – importance – DNA finger printing – methodology and application –methods of gene therapy – biosensors – types and application of biochips, Biological Databases and Websites.

Text book:

1. Dubey, R.C. Text Book of Biotechnology. S. Chand & Co. 2004.

Reference Books:

1. Balasubramania. D. Concepts of Biotechnology, University Press (India) Ltd., Hyderabad. 1996.
2. Chopra, U.L. and Narim. A. Genetic Engineering and Biotechnology. Oxford & IBH, New Delhi. 1996.
3. Dharmarajan, M. Genetic Engineering. S. Viswanathan & Co. 1989.
4. Dubey, R.C. Text Book of Biotechnology. S. Chand & Co. 2004.

09BT243 APPLIED MICROBIOLOGY

Credits: 3:0:0

Objective

To develop skills of the students in the field of microbiology to understand the basics and recent developments.

Outcome

At the end of the course, the students would have learnt about the scope, history, microbial interaction, biofertilizers, enzyme production etc. This will serve as an effective course to understand bioremediation of microbes and manipulation of microbes for our benefit.

Unit I :
Definition and scope of Microbiology - History and recent developments - spontaneous generation - Biogenesis-contributions of Louis Pasteur - Leewenboek, Lazaro Spallanzani, John Tyndall, Joseh Lister - Robert Koch, Culturing methodology and sterilization techniques.

Unit II :

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Anatomy of prokayotes and eukaryotes - structure and function of cell wall, cilia, flagella, slime layer, capsule, pili, cytoplamic membrane and cytoplasmic inclusions, sporulation.

Unit III :
Microscopy: simple, compound light microscopy - Dark ground - Phase contrast - Fluorescence and Electron Microscopy. Microbial kingdoms - Five kingdoms - cell theory - Binomial nomenclature of microbes

Unit IV:
Host microbe interaction, bacterial, viral, fungal pathogens, Antimicrobial chemotherapy - Antibiotics - source - classification - mode of action - Antimicrobial resistance - Tests for sensitivity to antimicrobial agents and its quality control.

Unit V:
Sewage disposal and treatment-Physical and biological.Microbes in air. Methods of purification of air. Preservation of food, Microbes in the production of organicacids – Lactic acid, antibiotics -Penicillin and alcoholic beverages – Beer and Wine, Vitamins – Cyanocobalamin, Enzyme – Amylase

Text Book:

1. Pelczar M.J., E.C.S Chan and N.R Kreig Microbiology 5 th edition, Tat McGraw Hill Publishing Company, New Delhi 2003
2.Prescott, M.J., Harley, J.P and Klein, D.A. Microbiology 5th Edition, WCB Mc Graw Hill, New York2002.

Reference Books:

1. General Microbiology by H.G. Schlegel (7 th Edition) Cambridge University Press, 2006
2. Reddy, S.R. and Singara Charya, M.A.. A Text Book of Microbiology - Applied Microbiology. Himalaya Publishing House, Mumbai. 2007
3. Singh, R.P. Applied Microbiology. Kalyani Publishers, New Delhi. 2007.
4. General Microbiology by Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is & P.R. Painter, 1998
5. Reddy, S.R. and Singara Charya, M.A. A Text Book of Microbiology - Applied Microbiology. Himalaya Publishing House, Mumbai. 2007.

09BT244 INTRODUCTORY CELL BIOLOGY

Credits: 3:0:0

Objective

To develop skills of the students in the field of cell biology and its applications in various fields.

Outcome

At the end of the course, the students would have learnt about the functions of organelles and structure, organization & reproduction of bacteria, yeast, fungi, algae, bacteriophage, plant

viruses, animal viruses etc. This will serve as an effective course to understand signal transduction and cyclic pathway of cells

UNIT I Cell Structure And Functions Of Organelles
Eukaryotic and Prokaryotic cells – Principles of membrane organization – membrane proteins (Internal and external) .

UNIT II Cell division – mitosis and meiosis – cell cycle and factors that control cell cycle.
Structure, Organization & reproduction of bacteria, yeast, fungi, algae, bacteriophage, plant viruses and animal viruses.

UNIT III Transport Across Cell Membranes
Passive and active transport – permeases – sodium – potassium pump ,Toxins and their mode of entry into cell-Cholera and Diphtheria

UNIT IV Receptors And Models Of Extra Cellular Signaling
Cytosolic – Nuclear and membrane bound receptors Autocrine, paracrine and endocrine models of action – Quantitation and characterization of receptors

UNIT V Signal Transduction
Signal amplification pathways, cyclic AMP, role of inosital phosphates, cyclic GMP, G proteins and calcium ion role in cell signaling

Text Books

1.Dornel J. Lodish H, Baltimore D. "Molecular Cell Biology", W.H. Freeman, 1990

2.Kimball I.W., "Cell Biology", Wesely Publishers, 1989.

Reference Books:

1.Gerald Karp and Nancy L Puritt, "Cell and Molecular Biology - Concepts and Experiment", John Wiley and Sons, Inc, 1998.
2.De Robertis, E.D.P and De Robertis, E.M.F., "Cell and Molecular Biology" 6th Edition, Saunders College, Philadelphia, 1990.
3.Wolfe, Stephen L., "Molecular and Cellular Biochemistry", Wadsworts, Inc. California, 1999.

09BT245 INTRODUCTORY GENETIC ENGINEERING

Credits: 3:0:0

Objective

To develop skills of the students in the field of genetic engineering concepts and applications to build their knowledge mainly in manipulation of DNA.

Outcome

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At the end of the course, the students would have learnt about the cloning vectors, DNA finger printing, blotting, autoradiography etc. This will serve as an effective course to understand concepts and applications of recombinant DNA technology.

UNIT I Basic Tools In Genetic Engineering
Restriction enzymes- Ligases-Modifying enzymes Southern hybridization-Northern hybridization; Autoradiography; PCR-different kinds-Application; DNA sequencing; DNA finger printing-RFLP Analysis-chromosome walking.

UNIT II Cloning Vectors-Prokaryotes
Plasmid biology-Plasmids as vectors- PBR322- Derivatives of pBR 322- pUC vectors-Other artifical plasmids-Phage-Lifecycle-M13-Lambda phages-Invitro packaging-Cosmids-Phasmids

UNIT III Cloning Strategy
Construction of recombinant DNA: Preparation of competent cell-Transformation, transfection-Recombinant selection and sereening; Genomic DNA library,cDNA library-

UNIT IV Expression Vectors
Eukaryotic cloning vectors- Eukaryotic expression vectors- Yeast expression system-Retroviral vectors-Bacullovirus, Mammlian cells-SV40; Gene transfer techniques.

UNIT V Gene Modification & Application Of Recombinant DNA Technology
Mutagenesis-Deletion mutagenesis, Oligonucletoide derived mutagenesis, Site directed mutagensis-Its applications; Applications of rDNA technology in Diagnostics; Pathogensis; Genetic diversity; Therapeutic proteins-Vaccines

Text Books:
1.Dubey, R.C.. Text Book of Biotechnology. S. Chand & Co. 2004
2.Gupta P.KElements of Biotechnology. Rastogi Publications, Meerut. . 2004.

Reference Books:
1.Genetic Engineering by Nicholas.1998
2.Gene Cloning by T.A.Brown,2001
3.Old R.W.Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering- Backwell Scientific Publications,1993

09BT246 ROLE OF BIOTECHNOLOGY IN ENVIRONMENT

Credits: 3:0:0
Objective

To develop skills of the students in the field of environmental biotechnology and its applications.

Outcome

At the end of the course, the students would have learnt about the social issues of pollution, waste water management, biodiversity and conservation etc. This will serve as an effective course to understand bioremediation and biodegradation of wastes.

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Unit 1: **Environmental pollution and social Issues**
Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal. Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.

Unit 2: **Industrial Waste Water Management**
Purification of waste water; Aerobic and anaerobic treatments; Management of radioactive pollutants in water, , COD and BOD sensors.

Unit 3: Biomass, Energy and Solid waste Management
Biomass waste as renewable source of energy; Methods of energy production; Conversion of Solid Waste to Methane; Biogas production; Management of Sludge and Solid waste treatment- Land filling, lagooning, Composting and Vermi Composting.

Unit 4: **Biodiversity and Conservation**
Definition, Types, Genetic, Species, Ecosystem; Biodiversity at Global Levels; Values of Biodiversity; Hotspots in Biodiversity; Loss of Biodiversity and its causes threats to Biodiversity; Biodiversity and its Conservation- In situ and Ex situ bio conservation

Unit 5: **Bioremediation and Biodegradation**
Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation;

Text Book:

1. Dubey, R.C. Text Book of Biotechnology. S. Chand & Co. 2004.

Reference Books:

1 Indu shekhar Thakur, Environmental Biotechnology- Basic concepts and Applications. 2006
2 Foster C.F; Johnware D.A, Environmental Biotechnlogy.Ellis Harwood Ltd. 1987.
3 Gupta P.K. Elements of Biotechnology. Rastogi Publications, Meerut. 2004.

09BT247 BASICS OF BIOMOLECULES

Credits: 3:0:0
Objective

To develop skills of the students in the field of structure and properties of biomolecules.

Outcome

At the end of the course, the students would have learnt about the structure and properties of carbohydrates, lipids, nuclic acids, proteins etc. This will serve as an effective course to understand the classification, diagnostic and therapeutic applications of enzymes.

Unit I: **Structure and Properties of Carbohydrates and Lipids**

Structure and properties of mono, di, oligo and polysaccharides, Structure, classification and properties of fatty acids and steroids.

Unit II: Structure and Properties of Proteins and Nucleic Acids
Structure, classification, and properties of amino acids and proteins. Structure and properties of purines, pyrimidines, nucleic acids.

Unit III: **Intermediary Metabolism and Bioenergetics**
Carbohydrate Metabolism: Glycolysis, TCA cycle, gluconeogenesis, glycogenesis, , Urea Cycle. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation .

Unit IV: Enzymes and Vitamins
Classification, properties, diagnostic and therapeutic applications of enzymes.
Vitamins: Classification, functions, dietary sources, daily requirements and clinical orientation of water soluble and fat soluble vitamins

Unit V:Hormones
Hormones: Classification, biochemical action and biochemical functions of estrogen, androgen, calcitrol (group I hormones), cAMP, FSH and LH (group II hormones).

Text book:
1. Lehninger, AL, Nelson DL and Cox MM, Principles of Biochemistry,5th edition 2008
2. Dr.U. Satyanarayana, Biochemistry, 2nd edition, Uppala Author Publishers Interlinks 2003

Reference Books:
1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 3rd edition 2008.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., Harper's Biochemistry, Prentice Hall International.,27th edition 2007.

09BT248 GENE AND GENE EXPRESSION

Credits: 3:0:0
Objective

To develop skills of the students in the field of genetics.

Outcome

At the end of the course, the students would have learnt about the genetic materials, replication of DNA in eukaryotes, genetic code, transcription, translational modifications, localization of proteins etc. This will serve as an effective course to understand the molecular basis of mutations.

UNIT I Structure Of Nucleic Acid
Structure of DNA, different forms of DNA and RNA, Identification of DNA as genetic material- Griffith, Avery, McLeod and McCarty, Frankel and Singer, Hershey and Chase, Meselson and Stahl experiment

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UNIT II Replication Of Nucleic Acids
Semi conservative replication, different models of replication in prokaryotes, replication of DNA in Eukaryotes, Telomeric DNA replication

UNIT III Expression - Transcription And Translation
Synthesis and processing of different forms of RNA, their importance-Genetic code-Transcription-Eukaryotes & Prokaryotes; Translation in Prokaryotes and Eukaryotes;

UNIT IV Splicing And Mutation
RNA splicing-retroposons; Molecular basis of mutation; different types of mutation; UV repair mechanisms.

UNIT V Gene Regulation
Gene regulation-operon concept-gal, lac, trp

Text Books
1. Dubey, R.C. Text Book of Biotechnology. S. Chand & Co. 2004.
2. Gupta P.K. Elements of Biotechnology. Rastogi Publications, Meerut. 2004.
3. S.Ignacimuthu.S.J. Plant Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. 2004.

Reference Books
1. T.A Brown, Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002.
2. Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM,. Molecular Biology of the Gene. 1987
3.DavidFriefelder,"MolecularBiology",NarosaPubl.House.1999

09BT249 INTRODUCTORY MICROBIAL BIOTECHNOLOGY
Credits: 3:0:0
Objective

To develop skills of the students in the field of microbial biotechnology and its applications.

Outcome

At the end of the course, the students would have learnt about the interaction of micro organisms in the field of pharmaceutical, agricultural, food industries etc. This will serve as an effective course to understand the biomass energy production

Unit – I: Introduction to Microbiology
Basic of microbial existence: history of microbiology, Multiplication of bacteria, viruses, algae and fungi. Nutrient requirements of bacteria, bacterial growth curve, aerobic and anaerobic bacteria, Preservation and maintenance of microbes.

Unit – II: Microbes in pharmaceutical, food industries and Agriculture
Production, harvest, recover/uses and mode of action – enzymes, antibiotics, vitamins (B12), organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), amino acids, beverages (beer, wine), single cell protein (SCP), biofertilizer, biopesticide.

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Unit – III: Bioremediation
Xenobiotics-microbial mechanism, microbial mining, - Bioreactors for waste water treatment-Activated sludge process, Biological filters, Rotating biological contactors (RBC), Fluidized bed reactors (FBR) Use of immobilized enzymes and microbial cells.

Unit – IV: Biotechnology for solid waste management
Solid waste treatment - Composting, Vermicomposting, animal feed, mushroom cultivation, oil spill remediation, biomedical waste treatment.

Unit-V: Biomass energy
Energy sources – A general account, useful features of biofuel, biomass- definition and modes for utilization of biomass, biogas production, bioethanol and biodiesel.

Text Books:

1 Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India; 2001.
2 Wolf Cruger and Anneliese Cruger, Biotechnology: A text book of industrial microbiology, Panima publishing corporation. 2003

Reference Books:

1 Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi. 2007.
2 Trivedi, P.C., 1st Edition. Microbial Biotechnology, Aavishkar Publisher 2004.
3 Das H K, , 2nd Edition, Text Book of Biotechnology, Wiley Dreamtech Pvt Ltd. 2005.
4 Microbial biotechnology: Glazer, A.N. and Nikaido, H. W.H. Freeman &Company, New York. 1995.
5 Jogdand SN, Environmental Biotechnology, Himalaya publishing house, Bombay 1995.

09BT250 APPLIED BIOTECHNOLOGY

Credits: 3:0:0
Objective

To develop skills of the students in the field of applications in biotechnology.

Outcome

At the end of the course, the students would have learnt about the tissue culture, bioreactors, cloning, biofertilizers, vernalisation, photo periodism etc. This will serve as an effective course to understand the gene expression and human biology.

UNIT 1: Cells, Tissue, and Organs
Introduction to the basic principles of cell structure, the organization of cells into tissues and organs.

UNIT 2: Cell and Molecular Biology
Introduction to the basic principles of biochemistry and molecular biology, DNA, genetic code.

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UNIT 3: Genetics and Genetic engineering
Principles of Mendelian inheritance and chromosomal basis of heredity, Lamarckism Lysenrko. Transgenics, GMOs, Stem cells and applications, gene therapy.

UNIT 4: Plant Biology

Biotechnology definition, history and scope, Isolation and cultivation of economically important microbes. Tissue culture- media, Micropropogation, callus formation and protoplast fusion, Single cell protein,. Biofertilizers- Production of primary and secondary metabolites.

UNIT 5: Human biology
Nervous system, brain, parts of brain and their functions; circulatory system, heart and its function. Overview of Immune system -active, passive and adaptive immunity. Organs and cells involved in immune responses

Text books:
1. Gupta P.K.. Elements of Biotechnology. Rastogi Publications, Meerut. 2004
2. Dubey, R.C.. Text Book of Biotechnology. S. Chand & Co. 2004

Reference Books:
1. T.A Brown , Genome, 2nd Edition, BIOS Scientific Publishers Ltd, 2002.
2. Kuby, J., Immunology. W.H. Freeman and Company, New York1994,
3.Trivedi, P.C., 1st Edition. Microbial Biotechnology, Aavishkar Publisher(2004)

4. Trevan, M.D.. Biotechnology. The Biological Principles. Tata Mc Graw Hill Publishing Co., New Delhi. 1993

09BT251 INSTRUMENTAL METHODS OF ANALYSIS

Credit:3:0:0

Objective
To develop skills of students in instrumentation and biological techniques.

Outcome
At the end of this course, the students would have learnt about principles of spectroscopy, nephelometry & chromatography and all biotechniques

Unit I Buffer Solutions (13)
Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H_2 electrode and glass electrode. calibration of instrumental methods

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Unit II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer (13)

Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

Unit III Chromatography and Electrophoresis (13)

Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC. Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis.

Unit IV Radio active techniques (13)

Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Applications in Medicine & Diagnosis.

Unit V Thermo Analytical Techniques (13)

Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC)

Total: 65 Hours

Text Books

1 Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 2002.
2 Instrumental Methods of Analysis, D. Skoog, 2000.

Reference Books

1 Ewing GW, Instrumental methods of Chemical Analysis, McGraw Hill Book Company, 1989.
2 Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987

BT252 NANOBIOTECHNOLOGY

Credit: 3:0:0
Objective:
The aim of the course is to provide basic knowledge on nanobiotechnology

Outcome:
At the end of the semester the students would have learnt about Nanoparticles, clinical application and ethical issues of nanobiotechnology

UNIT 1
Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology

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UNIT 2

Nano Particles :Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Nano Particles, Nano wires and Nanotubes.

UNIT 3

Application: Nanomedicine, Nanobiosensor and Nanofludics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials

UNIT 4

Nanobiotechnology: Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nanocarbon tubules. Nanosurgical devices.

UNIT 5

Ethical Issues in Nanotechnology: Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Social and Ethical Issues, Economic Impacts, Future Socio-economic Challenges

Text Books

1. Ratner M, Ratner D – "Nanotechnology: A Gentle Introduction to the next Big idea", Prentice Hall, 2003.
2. H. S. Nalwa – "Encyclopedia of Nanoscience & Nanotechnology" McGraw Hill, 2004.

Reference Books

1. CNR Rao – " The chemistry of Nanomaterials: Synthesis, Properties & Application" Springer 2006
2. Viola Vogel –" Nanomedicine & Nanotechnology", John Willey & Sons Ltd., 2008.
3. Goodsell – " Nanobiotechnology", John Willey & Sons Ltd., Third edition, 2004.
4. Ralph S. Greco, - "Nanoscale Technology in Bilogical systems", CRC Press, 2005

BT253 CANCER BIOLOGY

Credit : 3:0:0

Objective:

The aim of the course is to provide basic knowledge on cancer biology

Outcome:

At the end of the semester the students would have learnt about Carcinogenisis, Early diagnosis of cancer and about treatment methods to cure cancer.

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UNIT I : Fundamentals Of Cancer Biology

Different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II : Principles Of Carcinogenesis

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III : Principles Of Molecular Cell Biology Of Cancer

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity.

UNIT IV : Principles Of Cancer Metastasis

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V :New Molecules For Cancer Therapy

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

Text Books

1. Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2. Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce. The Biological Basis of Cancer. Cambridge University Press, New York 2003.

Reference Books:

1. Macdonald F and Ford CHJ. Molecular Biology of Cancer. Bios Scientific Publishers, 2002.
2. Maly B.W.J, “Virology A Practical Approach”, IRLl Press, Oxford, 2001.

09BT254 BASIC RESEARCH METHODOLOGY

Credit: 2:0:0

Objective

To impart the knowledge about the method by which the research has to be carried out.

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Outcome
The students will be familiar with experimental design data collection and Biostatics.

UNIT I Introduction to Ethical Issues
Safety and risk of bioethical concerns, Biotechnology's impact on society, Genetic engineering and biowarfare. The future of bioethical biotechnology, the Genetic revolution: Ethical issues. IPR, patent.

UNIT II: Laboratory safety Measures
Laboratory safety, bio safety, recombinant material safety, Standard operation protocol.

UNIT III Experimental Design
Essential steps in research, defining the research problem, Research/Experimental design, Literature collection, Literature citation,

UNIT IV: Biostatistics
Definition and scope, Types of biological data – Collection and presentation of data (Table, Graphs, Diagrams). Probability analysis – Testing of significance – Goodness of fit (X^2 test) – Student's 't' test Analysis of Variance.

UNIT V: Manuscript/Thesis Formulation
Research report: components, Format of thesis and dissertation, Manuscript/research article preparation, Review monographs, Bibliography and Reference, Significance of research.

Text Books:
1. C.R. Kothari, II edition (2004) Research methodology, Methods and techniques, New Age Internation (P) Ltd, Publishers, New Delhi.
2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.

Reference Books:
1. Donald H. McBurney, research methods, Thomson Asia Pvt. Ltd. Singapore, 2002
2. Ranjit Kumar, Research methodology, Sage Publications, London, New Delhi, 2006.
3. Raymond – Alain Thie' tart, et. Al., Doing Management research, Sage publications, London, 2001.

09BT255 ANIMAL AND PLANT TISSUE CULTURE LAB

Credits 0:0:2

List of Experiments
1. Packing and sterilization of glass and plastic wares for tissue culture
2. Preparation of reagents and media for cell tissue culture
3. Quantification of cells by trypan blue exclusion dye
4. Isolation of macrophages and cultivation of macrophages
5. Primary cell culture from chick embryo fibroblast
6. Cryopreservation

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7. Isolation and culture of T lymphocytes from Thymus
8. Preparation and Sterilization of MS media
9. Sterilization and inoculation of explants
10. Callus and Sub culturing from explants
11. Rooting media preparation, sterilization and rooting of explants
12. Micro grafting and hardening of explants
13. Genetic transformation by using Plasmid

References

1. R. I. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss,2005.
2. John R.W. Masters, Animal Cell Culture: Practical Approach, 3rd Edition, Oxford, 2006.
3. M. Clynes, Animal Cell Culture Techniques, 2ndt Edition, Springer,2006.

09BT256 INDUSTRIAL SAFETY

Credits 3:0:0

Objective:

To provide basic knowledge of hazards and therefore the necessary safety measure in industrial planning and function.

Outcome:

At the end of the semester student would have learnt about occupational health, industrial hygiene, accidental prevention techniques to the students and risk assessment and management.

Unit- 1 Safety and Health Management

Occupational Health Hazards, Promoting Safety, Safety and Health training, Ergonomics. Importance of Industrial safety, role of safety department, Safety committee and Function

Unit- 2 Plant design and Housekeeping

Plant layout, design, Ventilation, Air conditioning, Safety and good housekeeping, Disposal of scrap and other trade wastes, Spillage prevention, Use of colour as an aid of housekeeping, Cleaning methods, Inspection and Checklists, Advantages of good housekeeping

Unit – 3 First aid and Safety equipments

First aid - fracture and dislocation, injuries, bleeding, burns, accidents caused by electricity, Respiratory problems, Rescue and Transport of Casualty. Personal Protective Equipments and devices.

Unit – 4 Electrical Hazards and Hazards in Construction Industry

Overload and Short circuit protection, Earthing standards, Protection against voltage fluctuations, Effects of shock on human body Hazards from Borrowed neutrals, Electrical equipment in hazardous atmosphere.

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Unit – 5 Legislative measures in industrial safety

Factories Act, 1948, Workman's Compensation Act, 1943, Employees State Insurance Act, 1948.Child Labour and Women Employee Act. The factories rules and regulations.

Industrial Visit: Report – Mandatory

Text Book:

1. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)

Reference Book:

1. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

09BT257 RENEWABLE ENERGY SYSTEM

Credits 3:0:0

Objective:

To provide Engineers with inter-disciplinary skills and an understanding of energy systems because they will be in demand in energy supply companies, energy consulting and financing companies, energy equipment manufacturers, energy intensive manufacturing and process industries.

Outcome

The background provided in this course will equip students with the tools and techniques required to analyze and improve conventional energy systems and design the sustainable energy systems of the future.

Unit 1 INTRODUCTION

World energy use-reserves of energy resources-energy cycle of the earth-environmental aspects of energy utilisation-renewable energy resources and their importance.

Unit – 2 SOLAR ENERGY

Introduction -extraterrestrial solar radiation - radiation at ground level-collectors-solar cells-applications of solar energy-Biomass Energy-Introduction-Biomass Conversion-Biogas Production-Ethanol Production-Pyrolysis and Gasification-Direct Combustion-Applications.

Unit -3 WIND, GEO THERMAL AND HYDRO ENERGY SOURCES

Introduction-basic theory-types of turbines-applications-Geothermal Energy-Introduction-geothermal resource types-resource base-applications for heating and electricity generation-Hydropower-introduction-basic conceptssite selection-types of turbines-small scale hydropower.

Unit -4 TIDAL ENERGY OTHER RENEWABLE ENERGY SOURCES

Introduction-origin of tides-power generation schemes-Wave Energy-Introduction-basic theory-wave power Devices. Introduction-Open and Closed OTEC cycles-biophotolysis-Ocean Currents-Salinity Gradient Devices- Environmental Aspects-Potential impacts of harnessing the different renewable energy resources.

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Unit-5 ENERGY AUDITING

Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

Text Books:

1. W.R.Murphy, G.Mc.Kay- Energy Management, 1st edition – Butterwolfer &Co.Ltd. (2001)
2.Conventional & non conventional energy resources by G.K.Roy Tata McGraw-Hill (2003)

References:

1. A.Duffie and W.A.Beckmann, Solar Engineering of Thermal Processes-John Wiley (1980)
2. T.N.Veziroglu, Alternative Energy Sources, Vol 5 and 6, McGraw-Hill (1978)
3. Conventional energy technology, Fuel and chemical energy by Tata McGraw- Hill book Co.Ltd. (1987)

Websites:

1. http ://www.solstice.crest.orgl ,2. http ://www.res-.ltd-com,3. http ://www.mnes.mic.in
4. http ://www.ireada.org,5. http://sundancepower.com

09BT258 BIOREMEDIATION FOR INDUSTRIAL SECTORS

Credits: 3:0:0

Objective:

This course is intended to provide beginning engineering students with a clear overview of the field of biotechnology in various industrial sectors.

Outcome

At the end of the semester the student will know about the various products and industries of biotechnology

Unit-1 Pulp & Paper Industry

Problems related with pulp and paper industry, Environmental impact of pulp and paper mills, Treatment of pulp and paper mill pollutants, Ex-situ and In-situ bioremediation, Bioconversion and bioutilisation of effluent for products.

Unit-2 Distillery Industry

Environmental impact and treatment of distillery industry effluents-Primary, secondary & alternative treatments, wetland method, Prospects of Bioutilisation for products-foods, feeds, Soil and land applications, Fertilizers, Production of fuels.

Unit-3 Leather Tanning Industry

Environmental impact of tannery effluents-hazards and prevention, Treatment of tannery effluents-chemical & biological methods, Advanced methods-phytoremediation, Bioreactors, Microbial heavy metal accumulation.

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Unit- 4 Petroleum industry
Crude oil desalting, Petroleum wastes and their impact on environment, Treatment of petroleum waste, Biodegradation and bioremediation, Microbial recovery and up gradation, Biological treatment of dyes.

Unit- 5 Food and Beverages Industry
Prospects of utilization of food and beverages wastes-biochemical modification, enzymatic treatment, Treatment of waste water, solid waste and contaminated soil, Industry specific bioremediation,

Text Book:
1) Indu Shekhar Thakur, Industrial Biotechnology –Problems and Remedies, 2006, I.K. International Pvt. Ltd, New Delhi.

References:
1) Pradipta Kumar Mohapatra, Textbook of Environmental Biotechnology, 2006, I.K. International Pvt. Ltd, New Delhi.
2) A. H. Patel, Industrial Microbiology, 2007, Macmillan India Ltd, New Delhi.
3)Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 2002.
4)An Introduction to Cellular and Molecular Biology of Cancer, J Oxford Medical Publications, 2003.

09BT301 CELL BIOLOGY AND ADVANCED BIOCHEMISTRY

Credit: 4:0:0
Objective
To enable the students to understand the various metabolic pathway and cell signalling

Outcome
The students will be familiar in transport mechanism and various metabolic pathways and their significance

UNIT I Structure, Function and Transport Mechanisms of the Cell (13)
Structure and function of Eukaryotic and prokaryotic cells- its membrane- Micelles- different types of proteins & extra cellular matrix. Transport in eukaryotic cells-Passive & active transport, trans-membrane potential coupled ATP generation, endocytosis and exocytosis. Transport into prokaryotic cells-group transportation. Entry of virus and toxins into cells.

UNIT II Cell-Cell Signalling and Apoptosis (13)
Receptors - endocrine models of action- signal amplification. Different models of signal transduction-signalling by protein kinases-serine/threonine kinase –tyrosine kinase-MAP kinases. Cell cycle –it's control molecules & mechanism-apoptosis-oncogenes.

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UNIT III Introduction to Biomolecules ***(13)***

Biomolecules: Occurrence, classification, structure, properties and functions of carbohydrates, proteins, lipids and vitamins. stabilization of proteins and nucleic acids. Structural and functional relationships in complex carbohydrates, proteins and nucleic acids.

UNIT IV Enzymes ***(13)***

Enzymes-action, specificity, classification, structure, properties and function of enzymes. Enzyme kinetics: Michales- Menton equation, enzyme inhibition, kinetics of competitive, non – competitive and mixed inhibitors, allosterism, application of enzymes.

UNIT V Metabolic Pathways and Bioenergetics (13)

Energy yielding biochemical pathways: Biodegradation of Leu, Thr, Met, Lys, Tyr, Phe, Trp, Glutamate, Arg and Cys, fatty acids, cholesterol, purines and pyrimidines. Glycolysis, TCA cycle, pentose phosphate pathway. Bioenergetics: Redox biochemistry, energy rich compounds, respiratory chain, oxidative phosphorylation and triose phosphate cycle.

Total: 65 Hours

Text Books

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. Principles of Biochemistry Third Edition (Freeman Publishers), New York. 2000.
2. Darnell J, Lodish H, Baltimore D, Molecular Cell Biology, W.H.Freeman Fourth edition 2002.

Reference Books

1. Harper's Biochemistry – Robert K., Md Murray,Daryl K. Granner,Peter A. Mayes, Victor W. Rodwell,Appleton and Lange, Robert K. Murray 2000.
2. Donald Voet and Judith G. Voet .Biochemistry – Volume 1 Biomolecules, Mechanisms of Enzyme Action, & Metabolism; 2004.
3. A Text Book of Biotechnology by B. N. Prasad Budha Academic Publishers Pv.Ltd.G. P.O.Box 20195 Kathmandu,Nepal 2003.

09BT302 CELL BIOLOGY AND ADVANCED BIOCHEMISTRY LAB

Credit: 0:0:2

List of Experiments:

1. Estimation of Protein by Lowry Method
2. Estimation of Total Carbohydrates by Anthrone Method
3. Estimation of Aminoacid by Ninhydrin Method
4. Estimation of Cholesterol by Zak's Method
5. Estimation of Ascorbic Acid by volumetric Method
6. Differentiation of blood cells using Giemsa staining
7. Estimation of DNA
8. Study of phase contrast Microscope
9. Estimation of Chlorophylls
10. Staining for various stages of mitosis in Allium cepa (onion)

09BT303 BIOCHEMICAL ENGINEERING

Credit: 4:0:0

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Objective

To acquire the knowledge about the various biochemical reactions and the ways to alter the biochemical pathways and about design and operation of bioreactors.

Outcome

At the end of the course the student will be familiar in fermentation process and metabolic stoichiometry and the way to enhance the product of interest

UNIT I Media Design and Media Optimization Methods: (13)

Criteria for good medium, medium requirements for Industrial fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods: Plakett Burman Design, Response Surface Optimization and Simplex Optimization methods.

UNIT II Sterilization for Fermentation processes (13)

Thermal death kinetics of microorganisms; Batch and continuous Heat- Sterilization of Liquid Media; Sterilization equipment – batch and continuous - air sterilization- sterilization by radiation and chemical sterilization-Filter Sterilization of liquid Media –Design of Depth filters

UNIT III Metabolic Stoichiometry and Bioenergetics (13)

Thermodynamics efficiency of gowth, cell growth and product formation; metabolic heat generation. Stoichiometry of Cell growth and product formation - elemental balances, available – electron balances, degrees of reduction of substrate and biomass; yield coefficients of biomass and product formation; maintenance coefficients; oxygen consumption and heat evolution in aerobic cultures.

UNIT IV Transport phenomena in bioreactors (13)

Mass transfer in heterogeneous biochemical reaction system: Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer coefficients (kla); role of aeration and agitation in oxygen transfer. Heat transfer processes in biological system.

UNIT V Process design and operation of Bioreactors (13)

Operational modes of reactors – batch, continuous, fed batch, repetitive batch, recycle and continuous cultivation; novel bioreactors: Stirred tank, air lift and loop reactor, packed – bed and hollow – fibre membrane bioreactors; reactors for waste – treatment processes; scale- up criteria for bioreactors.

Total:65 hours

Text Books:

1 Shuler and Kargi, Bioprocess engineering, Prentice Hall, Second Indian Reprint 2002.
2 Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 1999

Reference Books:

1 Atkinson, B. & Mavituna . F., Biochemical Engineering and Biotechnology Handbook, McGraw Hill (2nd Edition) 1993.

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2 Harvey W. Blanch and Duoglas S. Clark, Biochemical Engineering, Marcel Dekker Inc.1997
3 Bailey J.E. and Ollis, D.F. Biochemical Engineering Fundamentals, McGraw Hill, 1986.
4 Bioprocess Engineering Principles – Pauline M Doran, Academic Press, 1995

09BT304 CHEMICAL AND BIOCHEMICAL ENGINEERING LAB

Credit: 0:0:2

List of Experiments:

1 Over all heat transfer coefficient in Heat Exchangers
2 Darcy's Friction Factor
3 Pressure drop in fluidized bed column / Packed Bed column
4 Flow measurement through orifice meter/ Venturi meter
5 Minor losses due to sudden expansion, contraction and elbow
6 Screening analysis
7 Citric Acid Production by Solid State Fermentation
8 Enzyme Kinetics
9 Media Optimization by Plackett burman Design
10 Production of enzymes
11 Production of Amino acids
12 Comparitive study on rate of product formation using Immobilized enzyme & Free enzyme.

09BT305 ADVANCES IN GENETIC ENGINEERING

Credit: 4:0:0

Objectives :

The student will be familiar in the demonstrate the basic mechanisms of gene expression, methods of cloning , basics of sequencing and blotting techniques., various techniques in genetic engineering and the applications of ***genetic engineering*** with caution on their hazards

Outcome :

At the end of the semester the students would have learnt about the basic tools of genetic engineering, the steps in gene expression, the use of and the essence of genetic regulation control mechanisms in both prokaryotes and eukaryotes, Isolate DNA using agarose gel electrophoresis, Perform DNA probing, Perform DNA recombination and mapping analysis.

UNIT- I Molecular Biology (15)

Prokaryotic and Eukaryotic gene expression -Transcription and Translation, control and regulatory elements , Eukaryotic gene expression in E.coli – fused genes, unfused genes, Gene expression in transgenic animals and plants

UNIT- II Gene Cloning (13)

Introduction to Cloning-methods **.-** how to isolate a gene – plasmid , marker techniques, Gene library – construction and applications of genomic library, cDNA library, phage lambda versus

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cosmids for gene libraries, Mapping the DNA- restriction mapping DNA foot printing, chromosome walking, chromosome jumping.

UNIT- III Analysis of Nucleic Acids and Proteins (12)

DNA sequencing – MAXAM and GILBERT chemical method, SANGER and COULSON Enzymatic chain termination method – the primer, the template, the dideoxynucleotide termination and deoxynucleotides, the polymerase etc. , Messing's shotgun method, using computers for sequencing .Blotting techniques- Southern , Northern and Western.

UNIT- IV Techniques in Genetic Engineering (12)

DNA Engineering Techniques – oligonucleotide synthesis, linkers, adapters and connectors, Mutagenesis, Site Directed Mutagenesis; transposon mutagenesis, transposon tagging., Gene targeting, Repetitive DNA Sequences - Variable Number of Tandem Repeats (VNTRs)/ Minisatellite sequences, Short Tandem Repeats (STRs)/ Microsatellite sequences, DNA finger printing, Hybridization based DNA fingerprinting,, RFLP, RAPD- PCR-based DNA fingerprinting,

UNIT- V Applications and Hazards of Genetic Engineering (13)

Applications of DNA fingerprinting and Genetic Engineering – -Criminal investigation, personal identification, Immigration, Paternity disputes , Exploitation of genetic engineering, Transgenic plants and Transgenic animals Genetically Engineered Microbes, . stem cells and their applications, gene banks, Hazards and Impact of Genetic Engineering on society.

Total:65 hours

Text books :

1. Genetic Engineering Principles and Practice by Sandhya Mitra Macmillan Publ.2008.
2. Gene Biotechnology, by S.N. Jogdand Himalaya Publishing House 2003

Reference books:

1. Text book of Biotechnology edited by H.K. Das 2nd edn. Wiley India (P) Ltd. 2006
2. Principles & Techniques of Biochemistry and Molecular Biology Wilson & Walker 2006.
3. Molecular Biology and Biotechnology Walker and Rapley 4th edn. 2nd Indian reprint Panima Publishing Corpn. 2003
4. Biotechnological Innovations In Crop Improvement, Biotol Book series. Butteworth-Heinemann- An imprint of Elsevier 2004.
5. Text book of Biotechnology R. C. Dubey. 2nd edn. S. Chand & Co. New Delhi. Publ. Jasper Rees. 2005

09BT306 GENETIC ENGINEERING LAB

Credit: 0:0:2

List of Experiments:

1. Isolation of genomic dna from plant tissue
2. Isolation of genomic dna from animal tissue
3. Quantitative and qualitative analysis of isolated genomic dna using spectrophotometer
4. Elution technique for separated dna from agarose gel
5. Extraction of proteins from plant or animal tissue and confirmation with qualitative tests
6. Separation and identification of proteins by sds-page using coomassie brilliant blue stain
7. Isolation of plasmid dna from e.coli

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8. Restriction enzyme digestion of puc19 plasmid dna and testing with agarose gel electrophoresis
9. Ligation of fragmented puc19 plasmid dna and testing with agarose gel electrophoresis
10. Transformation competent cell preparation
11. Transformation of recombinant plasmid dna into competent cells
12. Polymerase chain reaction (pcr) for the given standard dna using pcr kit and verifying with agarose gel electrophoresis

09BT307 ADVANCED BIOPROCESS ENGINEERING

Credit: 4:0:0

Objective

To know about the various Bioprocess and the ways to enhance the production of industrially important bioproducts

Outcome

At the end of the semester the students will be able to analyze various bioprocess and it control. They will be able to know the various factors that will the kinetics of the microorganism

Unit- I Overview of Fermentation Processes and Scale-up Criteria (13)

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Scale-up criteria for mixing- power requirements for agitation; mass transfer correlations- dynamics of multiple interacting microbial species, Prey- Predator interaction oscillations.

Unit- II Data Analysis in bioprocess (13)

Collection and analysis of data on bioprocess engineering, mass and energy balances for steady state and unsteady state biochemical systems; Fluid flow and mixing;mass transfer in biological systems

Unit- III Reaction Kinetics in bioprocess (13)

Reaction kinetics for biological systems- M.M kinetics, enzyme deactivation kinetics; heterogenous reactions in bioprocessing- concentration gradients and reaction rates in solid catalysts, internal mass transfer in heterogenous reactions; Thiele modules - solid – liquid mass transfer correlations, minimizing mass transfer effects.

Unit- IV Bacterial growth kinetics (13)

Simple unstructured and structured kinetic models for growth of bacterial and filamentous organisms; growth associated product formation kinetics-Monod, Leude king piret models- formulation of models for various biochemical processing systems in steady and unsteady state conditions; Role of endogeneous metabolism in substrate utilization and growth

Unit- V Process Control (13)

Online data analysis of physico chemical parameter measurements for biochemical processes; Concepts of process control- Application of Artificial Intelligence, Fuzzy logic and neural networks in bioprocess control, Case studies on bioreactor control problems.

Total:65 hours

Textbooks:

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1 Biochemical Engineering Fundamentals – 2nd edition Bailey and Ollis, Mcgraw Hill 1986.
2 M.L. Shuler and F. Kargi," Bio-process Engineering", 2nd Edition, Prentice Hall of India,New Delhi. 2002.

Reference Books: Books

1 Biochemical Engineering by James M.Lee , Prentice Hall 1992
2 Bioreactors in Biotechnology – A practical approach by A.H.Scragg; 1991.
3 Bioreactor Design and Product Yield , Biotol Series, Butterworth – Heinemann; 1993.
4 Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001.
5 Roger Harrison et al., Bioseparations Science and Engineering,Oxford University Press, 2003.
6 Bioprocess Engineering Principles – Pauline M Doran, Academic Press, 1995

09BT308 BIOPROCESS ENGINEERING & DOWNSTREAM PROCESSING LAB

Credit: 0:0:2

List of Experiments:

1. Demonstration of a Fermentor and its components.
2. Determination of K_L a by sodium sulphite oxidation method
3. Centrifugation
4. Batch Sedimentation
5. Liquid-Liquid extraction
6. Batch Distillation
7. Ammonium Sulphate precipitation
8. Estimation of MM parameters
9. Effect of substrate concentration on growth of E.coli
10. Immobilization of Enzyme-α amylase
11. Effect of temperature on enzyme activity
12. Effect of pH on Enzyme activity
13. Production of wine
14. Estimation of Biomass

09BT309 METABOLIC REGULATIONS AND ENGINEERING

Credit: 4:0:0

Objective

To develop skills of the students in the area of metabolic engineering to alter the metabolic pathway to enhance the product yield.

Outcome

At the end of the course, the students would have learnt about various methods synthesis of primary and secondary metabolites and bioconversion.

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UNIT - I Overview of Primary and Secondary Metabolic Pathways (13)
A brief outline of processes for the production of some commercially important primary metabolites such as amino acids and alcohols, various classes of secondary metabolites such as secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids, Industrial enzymes such as proteases, amylases, lipases, cellulases etc.,and enzyme inhibitors such as inhibitors of cholesterol synthesis.

UNIT – II Metabolic Regulations (13)
Operon concept-Regulation of gene expression in prokaryotes-Lac operon. Regulation of gene expression in eukaryotes- catabolite regulation. Regulation of RNA synthesis by amino acid. Feedback regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feedback regulation, cumulative feedback regulation. Permeability control: passive diffusion, active transport, group transportation.

UNIT –III Metabolic Engineering of Primary Metabolites and enzymes (13)
Primary metabolites: Alteration of feedback regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites. Enzymes: Strain selection, improving fermentation, recognising growth cycle peak, induction, feed- back repression, catabolite repression, mutants resistant to repression, gene dosage.

UNIT – IV Metabolic Engineering of Secondary Metabolites (13)
Producers of secondary metabolites, Precursor effects, trophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

UNIT - V Metabolic Engineering in Bioconversions (13)
Metabolic bioconversion pathways, Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

Total:65 hours

Text book

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

Reference Books:

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., " Fermentation And Enzyme Technology ", John Wiley And Sons., 1980.
2. Zubay G., " Biochemistry ", Macmillan Publishers, 1989.

09BT310 ADVANCED IMMUNOTECHNOLOGY

Credit: 4:0:0
Objective

This course aims to develop the skills of the students in Immunotechnology, antigen antibody response, immunodiagonosis, immunopathology etc.

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Outcome

At the end of the course would have learnt about the mechanisms by which a human body interacts with a pathogenic microbe & how it eliminates it. Students, also familiarize themselves with immunopathology and immunotherapy.

UNIT I Antigens (13)

Types of antigen, their structure, preparation of antigen for raising antibodies, peptide antigens preparation, handling of animals, adjuvants and their mode of action, identification of antigens by molecular techniques

UNIT II Antibodies and Immunodiagnosis (13)

Recombinant monoclonal and polyclonal antibodies – their production and characterization, Western Blot analysis, Immunoeletrophoresis, SDS-PAGE, Purification and synthesis of antigens; ELISA – Principle and application; Radio Immuno Assay (RIA) – Principles and applications; non isotopic methods of detection of antigens – enhanced chemiluminescence assay.

UNIT III Techniques to assay Cell Mediated Immunity (13)

Identification of lymphocytes and their subsets in blood, T-cell activation parameters, estimation of cytokines, macrophages activation, macrophage microbicidal assays, invitro experimentation; application of the above technology to understand the pathogenesis of infectious diseases and treatment; cytotoxicity assay; helper T- cell assay; cytotoxic T- cell assay.

UNIT IV Immunopathology (13)

Preparation of storage of tissues, identification of various cell types and antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immunocytochemistry – immunofluorescence, immunoenzymatic and immunoferrtine techniques, immuno electron microscopy, ELISA and ELISPOT

UNIIT V Molecular Immunology (13)

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system production anti idiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies, immunotherapy with genetically engineered antibodies.

Total: 65 hours

Text Books:

1 Talwar G. P., and Gupta S.K., A Hand book of Practical and Clinical Immunology, Vol. 1 & 2, CBS Publications, 2004.
2 Weir D.M., Practical Immunology, Blackwell Publications, 2000.

Reference Books:

1 Austin J.M. and Wood K.J., Principles of Cellular and Molecular Immunology, Oxford University Press, Oxford, 2003.
2 Frank C. Hay, Olwyn M. R. Westwood, Paul N. Nelson, Hudson Practical Immunology, Blackwell Publishers; 1st edition, 2002.
3 Ivan Roitt, Essential Immunology, 10th Edn. Blackwell Scientific Publication, 2002.
4 Weir DM and Stewart, J, Immunology, 10th Edn. Churchill Livingston, New York. 2000.

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09BT311 IMMUNOTECHNOLOGY LAB

Credit: 0:0:2

List of Experiments:

1. Blood Grouping and Rh typing
2. Preparation of Plasma and Serum
3. Single Radial Immunodiffusion
4. Double Immunodiffusion – Ouchterlony Method
5. Immunoelectrophoresis
6. Counter Current Immunoelectrophoresis
7. Rocket Immunoelectrophoresis – Laurell method
8. Immunodiagnosis of Typhoid fever – Widal Test
9. Enzyme Linked Immunosorbent Assay
10. Preparation of Antigen and Various Routes of Immunization
11. Isolation of PBMC from blood and checking the viability using Trypan Blue assay
12. Quantitative precipitin assay
13. Serum Electrophoresis

09BT312 ADVANCED BIOPHARMACEUTICAL TECHNOLOGY

Credit : 4:0:0

Objective

To develop skills of students in Biopharmaceutical technology.

Outcome

At the end of this course, the students would have learnt about principles of pharmacokinetics, pharmacodynamics, drug delivery, analytical techniques and bioproducts.

Unit- I Fundamentals Of Pharmacy Practice

Pharmaceutical Biotechnology: An introduction, Origin & definition, Scope & Importance of Biotechnology; their applications, Microbes in Pharmaceutical industry, Methods of Gene transfer, Biotechnology production of Secondary Metabolites

Unit- II Pharmacokinetics And Pharmacodynamics

ADME properties- Mechanism of Drug Absorption, Distribution of drugs, Drug metabolism (Biotransformation of drugs), Excretion of drugs, Pharmacokinetics: Basic considerations. Mechanism of drug action.

Unit- III Pharmaceutical Dosage And Drug Delivery System

Materials & Formulations, Manufacture of Tablets, Capsules, Sustained Release dosage forms, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols. Drug delivery system – Formulation of proteins and peptides. Protein as drug delivery system. Controlled drug delivery system- transdermal. Novel drug delivery system- liposomes

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Unit IV Pharmaceutical Analytical Techniques

UV-Visible spectroscopy, Flame emission spectroscopy and atomic absorption Spectroscopy, Fluorimetry, Infrared spectrophotometry, Nuclear magnetic resonance spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, Chromatographic techniques, Electrophoresis, Radio immuno assay, X-ray diffraction methods.

Unit V Biological Products

Properties of biotechnology derived therapeutic products. Production of Human insulin, Interferons, somatotropin, human growth hormone, somatostatin, purification, characterisation & analysis- establishing safety & efficacy. Gene Therapy, vaccines, Monoclonal Antibody Based Pharmaceuticals, Recombinant Human Deoxyribonuclease

Text Books

1 Pharmaceutical Biotechnology by S.S. Purohit, H.N. Kakrani and A.K. aluja. Jodhpur, Agrobios, 2003.
2 Biopharmaceutics and Pharmacokinetics-A Treatise by DM Brahmankar, Sunil B Jaiswal,2005.

Reference books:

1. Gary Walsh "Pharmaceutical Biotechnology Concepts and Applications" by,2007
2. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, H., Allen, L., Popovich, N.. Williams & Wilkins. 1999.
3. Instrumental Methods of Chemical Analysis – B. K. Sharma - 2004.
4. Pharmaceutical Biotechnology, edited by Michael J. Groves, Second Edition,2006.
5. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 1992

09BT313 DOWN STREAM PROCESSING IN BIOTECHNOLOGY

Credit: 4:0:0

Objective

To develop skills of the students in the area of Downstream processing with emphasis on purification of products.

Outcome

At the end of the course, the students would have learnt about various methods of separation and purification of bioproducts.

Unit I Role of Downstream Processing In Biotechnology (13)

Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products), physico-chemical basis of bioseparation processes

Unit I I Primary Separation and Recovery Processes (13)

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Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods

Unit III Enrichment Operations (13)

Membrane based separations micro and ultra filtration theory, design and configuration of membrane separation equipment, applications, precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction) insitu product removal, integrated bioprocesing

Unit IV Product Resolution/Fractionation (13)

Adsorptive chromatographic separation processes, electrophoretic separations (all electrophoresis techniques including capillary electrophoresis) hybrid separation technologies (membrane chromatography, electro chromatography etc)

Unit V Product Polishing (13)

Gel Permeation Chromatography, dialysis, Crystallisation

Text book

1. Bioseperations: Principles and Techniques, B. Sivasankar,Published by PHI Learning Pvt. Ltd., 2006
2. Bioseparation Technology,Mishra Neeraj,Publisher: CRC Press,2008

Reference Books:

1. Bioseparations Science and Engineering ,Day, Trevor G, and Harrison, Roger G, and Rudge, Scott R,Publisher: Oxford University Press, USA, 2002
3. Handbook of Bioseparations,Satinder Ahuja,Published by Academic Press, 2000
4. HPLC of Biological Macromolecules,Karen M. Gooding, Fred E. Regnier, Contributor Karen M. Gooding, Fred E. Regnier,Published by CRC Press, 2002
5. Isolation and Purification of Proteins,Rajni Hatti-Kaul, Bo Mattiasson,Published by CRC Press, 2003
6. A Century of Separation Science, Haleem J. Issaq,Published by CRC Press, 2002

BT314 ANALYTICAL BIOTECHNOLOGY LAB

Credit 0:0:2

List of Experiments

1. TLC
2. Paper Chromatography
3. HPLC
4. GC
5. SDS PAGE Electrophoresis
6. ELISA
7. PCR
8. Lyophilizer
9. Agarose gel Electrophoresis

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10. X-ray Diffraction instrument
11. Differential Scanning Colorimetry.
12. Nephlometry

09BT315 RESEARCH METHODOLOGY

Credit: 4:0:0

Objective

To impart the knowledge about the method by which the research has to be carried out.

Outcome

The students will be familiar with experimental design data collection and Biostatics.

UNIT- I: Introduction to research (13)

The hallmarks of scientific research – the building blocks of science in research – relevance to preliminary information, the research process for applied and basic research. Hypothesis development. Laboratory safety, bio safety, recombinant material safety.

UNIT- II: Experimental designs (13)

The laboratory and the field experiment – internal and external validity – factors affecting internal validity. Measurement of variables – scales and measurements of variables. Developing scales: rating scale and attitudinal scales. Validity testing of scales developed. Reliability concept in the scales being developed. Stability measures. In vitro, in vivo and clinical trial designs, rules and regulation for animal and human experiments.

UNIT- III: Data collection methods (13)

Interviewing questionnaires etc. secondary sources of data collection. Guidelines for questionnaire design – electronic questionnaire design and surveys. Special date sources: focus groups, static and dynamic panels. Review of the advantages and disadvantages of various data collection methods and when to use each. Sampling techniques. Probabilistic and non – probabilistic samples. Issues of precision and confidence in determining sample size. Hypothesis testing. Determination of optimal sample size. Data relevance to intellectual property rights (IPR), bookkeeping.

UNIT- IV: Biostatistics (13)

Definition and scope, Types of biological data – Collection and presentation of data (Table, Graphs, Diagrams). Measures of central tendency, Dispersion : Skewness and Kurtosis; Probability analysis – Testing of significance – Goodness of fit (X2 test) – Student's – test – Simple & multiple regression – Correlation: Canonical Correlation – Correlation coefficient– ANOVA (one way and two way analysis). Factor analysis – Cluster analysis – Discrimnant analysis. Application of SPSS package.

UNIT- V: The Research Report (13)

The purpose of the written report – concept of audience – Basics of written reports. The integral parts of a report – the little of a report, the table of contents, the synopsis, the introductory section, method section, results section – discussion section – recommendations and implementation section and reference section.

Total: 65 hours

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Text Books:

1. Donald R. Cooper and remela S. Schindler, Business Research Methods, Tata McGraw Hill publishing company limited, New Delhi, 2000.
2. C.R. Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2001.

Reference Books:

1. Donald H. McBurney, research methods, Thomson Asia Pvt. Ltd. Singapore, 2002
2. G.W. Ticehurst and A.J. Veal, Business research methods, Longman, 1999.
3. Ranjit Kumar, Research methodology, Sage Publications, London, New Delhi, 1999.
4. Raymond – Alain Thie' tart, et. Al., Doing Management research, Sage publications, London, 1999.
5. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000

09BT316 INSTRUMENTATION AND BIOTECHNIQUES

Credit: 4:0:0

Objective

To develop skills of students in instrumentation and biological techniques.

Outcome

At the end of this course, the students would have learnt about principles of spectroscopy, nephelometry & chromatography and all biotechniques.

Unit-I Quantitative analysis (13)

Introduction - Spectrophotometer – Principle and application of Spectrophotometer – Visible, UV, Atomic absorption spectrophotometer – fluorimetry, Flowcytometry

Unit-II Separation and Analysis (13)

Principles of Chromatography: lon exchange, size exclusion, and Affinity column, HPLC and Gas chromatography, GLC: GCMS. Centrifugation high speed and ultra, Electrophoresis – Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis, Isoelectrofoccusing

Unit-III Structural Elucidation and Analysis (13)

Principles and applications of the following: Microscope – Flourescence, Confocal, Phase contrast, Electron (Scanning and Transmission) –Radio isotopic techniques-X ray diffraction, RIA, scintillation counter, GM counter, Autoradiography. NMR, CD, IR, DSC. Immunotechniques – ELISA, Immunoblotting, Characterization of chromosomes by various banding techniques.

Unit-IV Cell Culture and Molecular Biological Techniques (13)

Preparation of Culture media, Modes of sterilization, Culture of microbes, Plant and animal cell and Tissue, Bioprocess Engineering: Operation types: Continuous, Batch, Fed batch. Designs: Fluidized bed, Packed bed, Immobilization of enzyme and cells. Nucleic acid isolation –

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Isolation of genomic DNA, RNA, Plasmid DNA, PCR and; Blotting techniques and Hybridization techniques.

Unit-V Bioinformatics (13)

Biological data base-nucleotide, protein-structural and sequencial data base. Gene and protein expression data. Sequence analysis-BLAST, FASTA: Sequence comparision, alignment, building phylogenetic trees. Use of microarrays to study gene expression and protein expression. Molecular visualization tools study protein structure, bioinformatics and drug discovery.

Total: 65 hours

Text Books

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005
2. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 1992

Reference Books:

1. Jerrold H.Zar Biostatistical analysis, 5edn, Prentice-Hall, Inc. Upper Saddle River, NJ, USA. (2007)
2. Attwood. T.K and Parry-Smith D.J.. Introduction to Bioinformatics, Pearson education. Singapore. (2002)

09BT317 ADVANCED REACTION ENGINEERING

Credit : 4:0:0

Objective

To develop skills of students in the area of reaction engineering.

Outcome

At the end of this course, the students would have learnt about kinetics of heterogeneous reactions, effects of diffusion,biochemical reaction system, analysis and design of heterogeneous reactors.

Unit I Kinetics of Heterogeneous Reactions

Catalytic reactions, rate controlling steps, Langmuir-Hinshelwood model, Rideal-Eiley mechanism, steady state approximation, non-catalytic fluid-solid reactions, shrinking and un-reacted core model. Biological reactions in fermentation processes

Unit II External Diffusion Effects in Heterogeneous Reactions

Mass and heat transfer coefficients in packed beds, quantitative treatment of external transport effects, modeling diffusion with and without reaction.

Unit III Internal Transport Processes in Porous Catalysts

Inter pellet mass and heat transfer, evaluation of effectiveness factor, mass and heat transfer with reaction.

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Unit IV Analysis and Design of Heterogeneous Reactors

Isothermal and adiabatic fixed bed reactors, non-isothermal and non-adiabatic fixed bed reactors. Two – phase fluidized bed model, slurry reactor model, and trickle bed reactor model. Experimental determination and evaluation of reaction kinetics for heterogeneous systems.

Unit-V Bio Chemical Reaction system.

Enzyme fermentation, microbial fermentation introduction and overall picture, substance – limiting microbial fermentation, product limiting microbial fermentation

Text Books

1. Octave Levenspiel-"Chemical Reaction Engineering", Third edition – John Willey, 1999.
2. Bailey & ollis – "Biochemical Engineering Fundamentals", second edition – McGraw Hill, 1986.

Reference Books

1. Scott Fogler. H – " Elements of Chemical Reaction Engineering" – second edition – Prentice Hall of India Pvt. Ltd., 1995.
2. Charles D. Holland – "Fundamentals of chemical Reaction Engineering" Second edition – John willey & sons, 1990.
3. Ceoberry J. J – "Chemical & Catalytic Reaction Engineering", Fourth edition, McGraw Hill, 1996
4. Froment G. F. and Bischoff K. B. – " Chemical Reactor Design & Analysis", second edition, John Willey & Sons, 1997.

09BT318 MODERN SEPARATION PROCESSES

Credit : 4:0:0

Objective

To develop skills of students in the area of modern separation processes.

Outcome

At the end of this course, the students would have learnt about Recent advances in separation techniques, Types and choice of membranes, Commercial processes and its applications

Unit I

Review of conventional processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, process concept, Theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid-liquid separations involving a second liquid.

Unit II

Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors, centrifugal separators and their relative merits, Commercial, pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis. Economics of membrane operations, Ceramic membranes.

Unit III

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Mechanisms, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno Chromatography, Types of equipment and commercial process, Recent advances and process economics.

Unit IV

Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electro dialysis, Commercial processes.

Unit V

Separations involving lyophilisation, Pervaporation and permeation techniques for solids, liquids and gases, Industrial viability and examples, Zone melting, Adductive crystallization, Other separation processes, Supercritical fluid extraction, Oil spill Management , Industrial effluent treatment by modern techniques.

Text Book:

1. King, C.J., Separation Processes. Tata McGraw Hill, 1982

Reference Books:

1. Roussel,R.W., Handbook of Separation Process Technology, John Wiley, New York, 1987.
2. Nakagawal, O.V., Membrane Science and Technology, Marcel Dekker, 1992.

09BT319 ENERGY MANAGEMENT

Credit : 4:0:0

Objective

To develop skills of students in the area of energy management.

Outcome

At the end of this course, the students would have learnt about Energy sources, various forms; energy storage; Bio-geo-chemical cycles and Sources of continuous power.

Unit I

Energy sources; coal oil, natural gas; nuclear energy; hydroelectricity, other fossil fuels; geothermal; supply and demand; depletion of resources; need for conservation; uncertainties; national and international issues-Ozone layer depletion,photosynthesis-Global warming

Unit II

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources. Energy; various forms; energy storage; structural properties of environment.

Unit III

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Bio-geo-chemical cycles; society and environment population and technology. Energy and evolution; growth and change; patterns of consumption in developing and advances countries; commercial generation of power requirements and benefit.

Unit IV

Chemical industries; Classification; conservation in unit operation such as separation; cooling tower; drying; conservation applied to Bio-fertilizers, cement, pulp and paper, food industries, fermentation, pharmaceutical industries; conservation using optimization techniques.

Unit V

Sources of continuous power; wind ,Biogas-pyrolysis ; geothermal; tidal and solar power; MHD, fuel cells; Bio-fuel. Cost analysis; capacity, production rate, system rate; system cost analysis; corporate models; production analysis and production using fuel inventories, input-output analysis, economics; tariffs. Energy generation from Bio-wastes.

Text Book:

1. Krentz, J.H., Energy conservation and utilization, Allyn and Bacur Inc., 1976

Reference Books:

1. Gramlay, G.M., Energy, Macmillan Publishing Co., New York, 1975.
2. Rused, C.K., Elements of Energy Conservation, McGraw-Hill Book Co., 1985.

09BT320 UNIT OPERATIONS AND PROCESSES IN EFFLUENT TREATMENT

Credit : 4:0:0

Objective

To develop skills of students in unit operations and processes in effluent treatment.

Outcome

At the end of this course, the students would have learnt about principles of various unit operations used in effluent treatment.

Unit I

Selection of unit operations and processes- Principal type of Reactors- Screening – Mixing – Coagulation and Flocculation – Flow equalization.

Unit II

Sedimentation – Type of settling – Removal ratio – Clarifier – thickener – Column flotation – air floatation. Solid waste management in Biochemical industries

Unit III

Filtration – classification of filters – Head loss through filters – Darcy - equation.

Unit IV

Chemical precipitation – phosphate removal – Adsorption – Activated carbon – isotherms – Disinfection – Factors influencing – Breakpoint chlorination – Dechlorination.

Unit V

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Kinetics of biological growth – Suspended and attached growth processes – Aerobic and Anaerobic – Determination of kinetic coefficients.

Text Book:

1. Metcalf & Eddy, Inc. "Wastewater Engineering–Treatment, Disposal, and Reuse ", Third Edition, Tata McGraw-Hill, 1995.

Reference Books:

3. Casey. T.J."Unit Treatment Processes in Water and Wastewater Engineering", John Wiley & Sons. 1993.

09BT321 BIO-PLANT DESIGN AND PRACTICE

Credit : 4:0:0

Objective

To develop skills of students in bio-plant design and practice.

Outcome

At the end of this course, the students would have learnt about plant design, process economics, pharmaceutical water system, validation of biopharmaceutical facilities, good manufacturing practices.

Unit I Plant Design

Fomenter design, reactions vessels, piping and valves for biotechnology, Pressure relief system. Materials of construction and properties. Utilities for plant design.

Unit II Process economics

General fermentation process economics, materials usage and cost, capital investment estimate, production cost estimate. Two case studies – one traditional product and one recombinant product.

Unit III Pharmaceutical water system

Grades of water, sanitary design, water treatment system, water distribution system, validation-Sanitary design principles : Biochemical, food and pharma industries

Unit IV Validation of Biopharmaceutical Facilities

Introduction, Why Validation, when does validation occur, Validation Structure, Resources for validation, validation of Systems And Processes including Sip And Cip- Hazardous analysis: Food, Pharma and Biotech industries.

Unit V Good manufacturing Practices

Structure – quality management, personal, premises and equipment. Documentation, production, quality control, contract manufacturing and analysis, complaints and product recall, self inspection. Introduction to GLP and its principles.

Text Book:

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1 Peter, Max S. and Timmerhaus, Klaus D., " Plant Design and Economics for Chemical Engineers ", 5th Edition, McGraw Hill.1997.
2 "A Compendium of Good Practices in Biotechnology ", BIOTOL Series, Butterworth-Heiemann,1993

Reference Books:

1 Seiler,Jiing P., "Good Laboratory Practice; The why and How ?", Springer, 2001.
2 Lydersen, B.K. etal., "Bioprocess Engineering Systems, Equipment and Facilities",John-Wiley,1994.

09BT322 BIOLOGICAL WASTEWATER TREATMENT

Credit : 4:0:0

Objective

To develop skills of students in instrumentation and biological techniques in waste water treatment.

Outcome

At the end of this course, the students would have learnt about principles of operation of various reactors used in waste water treatment.

Unit I

Classification of Biochemical operations, fundamentals of biochemical operations, Stoichiometry and Kinetics of Biochemical Operations.

Unit II

Theory, modeling of ideal suspended Growth Reactors, Modeling Suspended Growth Systems. Aerobic Growth of Heterotrophs in a single Continuous Stirred Tank, Reactor Receiving Soluble Substrate, Multiple Microbial Activities in a Single Continuous Stirred Tank Reactor, Multiple Microbial Activities in Complex Systems, Techniques for Evaluating Kinetics and Stoichiometric parameters.

Unit III

Applications: Suspended Growth Reactors, Design and Evaluation of Suspended Growth Processes, Activated Sludge, Biological Nutrient Removal, Aerobic – digestion, Anaerobic Processes, Lagoons.

Unit IV

Theory: Modeling of Ideal Attached Growth Reactors, Bio-film Modeling. Aerobic Growth of Biomass in Packed Towers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

Unit V

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Applications: Attached Growth Reactors, Trickling Filter, Rotating Biological Contactor, Submerged Attached Growth Bioreactors, Future Challenges, Fate and Effects of Xenobiotic Organic Chemicals.

Text Book:

1. Graty. C.P.L.Daigger, G and Lim, H.C, Biological Wastewater Treatment. 2nd Edition, Marcel D ekker, 1998

Reference Book:

1. Mizahi A, Biological Waste Treatment, John Wiley Sons Inc 1989.

09BT323 MOLECULAR AND CELLULAR BASIS OF CANCER

Credit: 4:0:0

Objective

To develop skills of students in the area of cancer

Outcome

At the end of this course, the students would have learnt about basic principles of cancer biology,signal transduction, oncogenes and tumour suppressor genes and current concepts in cancer therapy.

UNIT I Cancer Biology: the Basics

Introduction, historical perspective and classification of cancer;

Carcinogenesis: Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X-ray and UV radiation-mechanisms of radiation carcinogenesis.

Cancer initiation, promotion, & progression, screening and early detection, Tumour markers

UNIT II Cell cycle regulation and Signal Transduction

Cancer cell cycles; Cell cycle control genes and mismatch repair genes; Growth factors, growth factor receptors and Signal transduction; Growth factor receptor kinases and cytoplasmic tyrosine kinases; Ras/MAPK pathway; Cyclic AMP and activation of CREB; JAK-STAT pathway; Transcription factors; Telomerases

UNIT III Oncogenes and Tumour Suppressor Genes

Apoptosis; Cellular proto-oncogenes and oncogene activation; Retroviral oncogenes; Tumour supressor genes; Retino Blastoma tumour suppressor genes and its significance. Tumour suppressor gene pathways; DNA methylation and epigenetic silencing of suppressor genes.

UNIT IV Understanding Natural History of Cancer Development

Free radicals, antioxidants and cancer; Metabolic oxidative stress and cancer; Genetic changes of selected cancers – Lung cancer, Breast cancer, Gastrointestinal cancers and other cancers; Cell-cell interactions, cell adhesion, angiogenesis, invasion and metastasis; Tumour associated antigens and Tumour specific antigens

UNIT V Current Concepts in Cancer Therapy

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Different forms of therapy – Chemotherapy, radiation therapy, surgery; Gene therapy and cancer; Applications of Monoclonal antibodies in cancer diagnosis and therapy.
Cancer immunity and strategies of anticancer immunotherapy;
Natural products and cancer; Immunomodulators in cancer therapy; diet and cancer.

Text Books

1 Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2 Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce. The Biological Basis of Cancer. Cambridge University Press, New York 2003.

Reference Books:

1 Macdonald F and Ford CHJ. Molecular Biology of Cancer. Bios Scientific Publishers, 2002.
2 Maly B.W.J, "Virology A Practical Approach", IRLl Press, Oxford, 2001.
3 Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 2002.
4 An Introduction to Cellular and Molecular Biology of Cancer, J Oxford Medical Publications, 2003.

09BT324 PHYTOCHEMICALS AND HERBAL MEDICINE

Credit : 4:0:0

Objective

To develop skills of students in Phyotochemical and herbal medicine.

Outcome

At the end of this course, the students would have learnt about principles of crude drugs, medicinal and aromatic plants, tissue culture, phytochemical analysis and its applications

Unit I: Crude Drugs

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs.
Indian System of medicine: Ayurveda, Siddha and Unani and its significance

Unit II: Medicinal & Aromatic Plants

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs. Modern Biotechnological tools and its influence in Medical and Aromatic plant cultivation.

Unit III: Tissue Culture of medicinal Plants

Plant Tissue Culture as source of medicines, Secondary metabolite production in plants; Plant Tissue Culture for enhancing secondary metabolite production (Withania somnifera, Rauwolfia

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serpentina, Catheranthus roseus, Andrographis paniculata, Dioscorea sp.); Anticancer, Antiinflammatory, Antidiabetic, Analgesicdrugs, Biogenesis of Phytopharmaceuticals.

Unit IV: Analysis of Phytochemicals

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical). Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods. Characterization of drugs.

Types of Phytochemicals:

Carbohydrates & derived products; Glycosides - extraction methods (Digitalis, Aloe, Dioscorea,); Tannins (Hydrolysable & Condensed types); Volatile Oils - extraction methods (Clove, Mentha);

Alkaloids - extraction methods (Taxus, Papaver, Cinchona); Flavonoids- extraction methods, Resins- extraction methods; Lectins.

Unit V:Applications of Phytochemicals

Application of phytochemicals in industry and healthcare; Biocides, Biofungicides, Biopesticides. Nutraceuticals and their significance.

Text Books:

1 Pharmacognosy, C. K. Kokate, A. P. Purohit & S. B. Gokhale Nirali Prakashan, 4th Ed. 1996
2 Natural Products in medicine: A Biosynthetic approach Wiley 1997.

Reference Books:

1 Hornok,L. (ed.) Cultivation & Processing of Medicinal Plants, Chichister, U. K:J. Wiley & Sons 1992.
2 Trease & Evans, Pharmacognosy – William Charles Evans, 14th ed. Harcourt Brace & Company 1989.

09BT325 ADVANCED PLANT BIOTECHNOLOGY

Credit : 4:0:0

Objective

To develop skills of students in the area of Plant biotechnology.

Outcome

At the end of this course, the students would have learnt about principles of basic techniques of genetic engineering, enzymes as molecular tools, gene transfer methods,plant transformation technology and its applications.

UNIT-I: Genetic engineering: Introduction to Gene Manipulation. Basic Techniques: Isolation and purification of Nucleic Acids (DNA, RNA), Agarose Gel Electrophoresis, Pulsed field electrophoresis. Southern, Northern and western blotting, PCR, .Converting mRNA transcripts into cDNA libraries, functional sequencing of cDNA Expression libraries.

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UNIT-II: Methods in genetic: enzymes as molecular tools - uses of restriction enzymes in plant genetic engineering, DNA modifying enzymes and their applications in recombinant DNA technology. Preparation of probes, nucleotide labling, radiolabling and alternatives, molecular probes. Nucleic acid microarray, gene knock out and silencing and RNAi.

UNIT-III: Methods of gene transfer in plants: transient and stable gene transformation. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation, silicon carbide mediated and floral dip method.

UNIT-IV: Plant transformation technology: Agrobacterium tumefaciens as plant genetic engineer: features of Ti and Ri plasmids, use of Ti and Ri as vectors, binary vectors, viral vectors and their applications.

UNIT-V: Application of plant transformation for productivity and performance: herbicide resistance, phosphoinothricin, glyphosate, sufonyl urea, atrazine, insect resistance, Bt genes, virus resistance, coat protein mediated, nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, antifungal proteins, thionins, PR proteins, nematode resistance, use of ACC synthase, polygalacturanase, ACC oxidase, carbohydrate composition and storage, ADP glucose pyrophosphatase. Golden rice, blue rose. Edible vaccines.

Text Books

1 H.S. Chawala, Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 2002.
2 S. Ignacimuthu S.J. Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2004.

Reference Books:

1 Plant molecular genetics by Monica. A. Hughes. Pearson Education limited, England. 1999.
2 Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2001
3 R.C. Dubay. A Text Book of Biotechnology. S.Chand & Campany Ltd. 2001.,
4 Glick and Pasternak, Molecular Biotechnology. 2001.
5 Adrian Slater, Nigel Scott, and Mark Fowler. Plant Biotechnology. The genetic manipulation of plants. Oxford University Press . 2008.

09BT326 BASICS OF CHEMICAL ENGINEERING

Credits 3:0:0

Objective:

This course is intended to provide beginning engineering students with a clear overview of the field of chemical engineering so they can confidently decide if they want to pursue chemical engineering as a profession.

Outcome:

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At the end of the semester the student will develop basic skills in problem solving, computation, process design and communication that will help them in all future engineering courses.

Unit-I Process calculations

Basic units and dimensions. Basics gas calculations-mole, mole percentage, weight, weight percentage molarity, molality, normality. Ideal gas laws. Material balance, energy balance.

Unit-II Fluid mechanics

Concept of fluid, types of fluid, properties of fluid, fluid flow, fluid flow pattern, flow control, fluid flow measurements and transportation of fluid.

Unit-III Unit operations

Concept of unit operations, heat transfer – modes of heat transfer, equipments – heat exchanger (double pipe, shell& tube, plate type), LMTD, heat transfer coefficients, concept of evaporator, filtration and mechanical separation

Unit-IV Mass transfer operations

Diffusion in fluids – molecular and eddy diffusion, concept of NTU and HTU. Distillation- concept, types, design calculation – Mc Cabe Thiele method, poncho savant method. Basic concept of absorption, adsorption, drying and leaching.

Unit-V Chemical Reaction Engineering

Law of mass action, rate equation, order of reaction, elementary and non elementary reactions, performance equation for CSTR,PFR.types of reactions and reactors, definition of space time, mean residence time

Text books:

1. Bhatt B.I. and Vora S.M. "Stoichiometry", Fourth Edition, Tata McGraw-Hill Pub. Co. Ltd., 2004.
2. Mccabe, W.L, Smith J.C., "Unit Operations in Chemical Engineering ", McGraw-Hill, seventh Edition, 2006

Reference books:

1. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.
2. Felder R.M. and Rousseau R.W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley and Sons, Inc., 2000.
3. Octave levenspiel, Chemical reaction engineering, John Wiley, fifth edition,2006

09BT327 RESEARCH METHODOLOGY

Credit: 3:0:0

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Objective
To impart the knowledge about the method by which the research has to be carried out.

Outcome
The students will be familiar with experimental design data collection and Biostatics.

UNIT I Ethical issues and Biosafety
Safety and risk of bioethical concerns, Biotechnology's impact on society, Genetic engineering and biowarfare. The future of bioethical biotechnology, the Genetic revolution: Ethical issues. IPR, patent. Laboratory safety, bio safety, recombinant material safety, Standard operation protocol.

UNIT II: Research Problems and Experimental Design
Essential steps in research, defining the research problem, Research/Experimental design, Literature collection, Literature citation, Impact factor of journals, Citation index of journals

UNIT III Instrumentation Techniques
Spectrophotometric methods, Microscopic techniques, Immunotechnoques and chromatographic techniques.

UNIT IV: Biostatistics
Definition and scope, Types of biological data – Collection and presentation of data (Table, Graphs, Diagrams). Probability analysis – Testing of significance – Goodness of fit (X^2 test) – Student's 't' test – Simple & multiple regression – Correlation: Canonical Correlation – Correlation coefficient– ANOVA (one way and two way analysis of variance).

UNIT V: Manuscript/ Thesis Writing
Research report: components, Format of thesis and dissertation, Manuscript/research article preparation, Review monographs, Bibliography and Reference, Significance of research.

Text Books:
1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age Internation (P) Ltd, Publishers, New Delhi.
2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.

Reference Books:
1. Donald H. McBurney, research methods, Thomson Asia Pvt. Ltd. Singapore, 2002
2. Ranjit Kumar, Research methodology, Sage Publications, London, New Delhi, 2006.
3. Raymond – Alain Thie' tart, et. Al., Doing Management research, Sage publications, London, 2001.

09BT328 ANIMAL AND PLANT TISSUE CULTURE LAB

Credits 0:0:2

List of Experiments

1. Packing and sterilization of glass and plastic wares for animal tissue culture

2. Preparation of reagents and media for cell, tissue culture
3. Spleen cell processing and culture of splenocytes
4. Bone marrow cell isolation, processing and culture
5. Macrophage culture and phagocytosis assay
6. Cryopreservation
7. Preparation and Sterilization of Basal, organogenesis and rooting media
8. Sterilization and inoculation of leaf, cotyledon and nodal explants
9. Callus and Sub culturing and etiolation of explants
10. Rooting, Micro grafting and hardening of explants
11. Protoplast isolation and protoplast fusion
12. Genetic transformation and hairy root production
13. Haploid production

References

1. R. I. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss,2005.
2. John R.W. Masters, Animal Cell Culture: Practical Approach, 3rd Edition, Oxford, 2006.
3. M. Clynes, Animal Cell Culture Techniques, 2ndt Edition, Springer, 2006.

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BIOTECHNOLOGY

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ADDITIONAL SUBJECTS

Code	Name of the Subject	Credits
10BT201	Basic Engineering Biochemistry	4:0:0
10BT202	Genetic Engineering and Bioethics	4:0:0
10BT203	Cancer Biology	3:0:0

10BT201 BASIC ENGINEERING BIOCHEMISTRY

Credits: 4:0:0

Objective

To study about the structure, composition and function of various biomolecules

Outcome

At the end of the semester the students will enable to understand the metabolism of carbohydrates, lipids, proteins and the bioenergetics.

Unit I Introduction to Biomolecules

Biomolecules-functional groups, 3D structure, stereospecificity, chemical reactivity, macromolecules. Water-Ideal biological solvent, biomedical .Effects on dissolved biomolecules. Ionization of water, water as reactant in living organisms. Fitness of aqueous environment for living organisms. Buffer and pH and –pH definition and scale. Buffer-definition, buffering in biological system, important biological buffers, buffer preparation Normality, molarity, molality, percentage dilution. Vitamins-occurrence, classification, structure, properties and functions of vitamins.

Unit II Structure and Properties of Carbohydrates, Lipids and Enzymes

Classification of carbohydrates. Structure and properties of mono, di, oligo and polysaccharides, Classification of lipids. Structure and properties of fatty acids, phospholipids, sphingolipids, glycolipids and cholesterol, lipid aggregates. Introduction to Enzymes-Nomenclature, Classification, enzyme reaction rates, enzyme catalysis, specificity. action-units, biological role of enzymes.

Unit III Structure and Properties of Proteins and Nucleic Acids

Structure and properties of amino acids, modified amino acids, peptides, proteins, Structure properties and functions of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, ribonucleic acids and deoxy ribonucleic acids, nucleoprotein complexes, chemistry of nucleic acids.

Unit IV Metabolism Of Carbohydrates, Lipids and Bioenergetics

Lipid Metabolism: Biosynthesis and biodegradation of fatty acids and cholesterol.

Carbohydrate Metabolism: Glycolysis-fate of pyruvate, pentose phosphate pathway, TCA cycle, glyoxylate cycle, gluconeogenesis, glycogenesis and glycogenolysis. Inborn errors of

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metabolism, triose phosphate cycle in plants. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain and oxidative phosphorylation

Unit V Metabolism Of Proteins And Nucleic Acids

Biodegradation of proteins and nucleic acids. Biosynthesis and biodegradation of important amino acids- Leu, Thr, Met, Lys, Tyr, Phe, Trp, Glutamate and Cys-Urea Cycle, transamination. purines and pyrimidines. Inborn errors of their metabolism.

Text book:

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.
2. Jain and Jain (2008). Biochemistry, Chand publication.

Reference Books:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.
3. Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., (2000). Harper's Biochemistry, Prentice Hall International.

10BT202 GENETIC ENGINEERING AND BIOETHICS

Credits: 4:0:0

Objective

Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation, r-DNA technology.

Outcome

At the end of the semester the students would have learnt about r-DNA technology, genomic library, PCR and other applications of genetic engineering and also ethical issues relating to genetically manipulated products

Unit I Basics of Recombinant DNA Technology

Overview of recombinant DNA technology - Steps, Restriction and modifying enzymes. Restriction mapping, design of linkers and adaptors. Applications- Recombinant cytokines and antibodies, vaccines, gene-therapy, stem cell therapy. Invitro fertilization, embryo transfer technology.

Unit II: Vectors and Cloning

Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors. Cloning in plants, transgenic and knockout animals.

Unit III Polymerase Chain Reaction & Construction of Libraries

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing. Diagnostic importance of PCR. Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

Unit IV Bioethics & IPR
Bioethics: The legal and socioeconomic impacts of Biotechnology. Intellectual property rights, TRIPS, GATT, International conventions, Patents and methods application of patents, Legal implications, Biodiversity and farmers rights.

Unit V Biosafety and rDNA guidelines
Biosafety regulation and National and international guidelines, r-DNA guidelines, Experimental protocol approvals, levels of containment. Definition of GMO & LMO; Roles of Institutional Biosafety committee, RCGM, GEAC etc for GMO applications in food and agriculture; Environmental release of GMOs- risk analysis and assessment.

Total : 65 hours

Text Books:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 2002.
2. Saleesha A.Stanely, “Bioethics”, Wisdom educational service, 2008.

Reference books:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987
3. Sambrook et al Vol. 1-3, “Molecular Cloning”

10 BT 203 CANCER BIOLOGY

Credits: 3:0:0

Objective:
The aim of the course is to provide basic knowledge on cancer biology

Outcome:
At the end of the semester the students would have learnt about Carcinogenisis, Early diagnosis of cancer and about treatment methods to cure cancer.

Unit I Fundamentals of Cancer Biology
Mitosis and Meiosis; Cell cycle; Check points in cell cycle, Cancer: Types of cancer, Cancer screening and early detection; Immunohistochemistry.

Unit II Carcinogenesis
Environmental factors in cancer development; physical and chemical carcinogens; Radiation and cancer; Theory of carcinogenesis, free radicals in carcinogenesis

Unit III Basics of Molecular biology of cancer
Tumour associated antigens, Tumour specific antigens, Tumour markers, Oncogenes, Tumour suppressor genes. Apoptosis and cancer: Basic concepts.

Unit IV Cancer development
Metalloproteases (MMPs); Tissue Inhibitors of Metalloproteases (TIMPs), Three step theory of invasion; cancer metastasis and angiogenesis.

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Unit V Cancer Therapy

Treatment modalities available for cancer: Radiation Therapy, Chemotherapy, Surgery. Gene Therapy.

Text Books

1. Robert A Weinberg, The Biology of Cancer, Garland Science Publishers, USA. 2006
2. Lauren Pecorino, Molecular Biology of cancer: Mechanisms, Targets and Therapeutics. Oxford University Press Inc. New York, 2008.

Reference Book:

1. "An Introduction to Cellular And Molecular Biology of Cancer", Oxford Medical Publications, 1991.

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SCHOOL OF BIOTECHNOLOGY & HEALTH SCIENCES

DEPARTMENT OF BIOTECHNOLOGY

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REVISED & NEW SUBJECTS

Code	Subject	Credit
09BT329	Molecular Biology and Nanotechnology applications in Cell Biology	4:0:0
09BT330	Cancer Chemotherapy	4:0:0
09BT331	Mental Health Care	4:0:0
09BT332	Biofuel Cells	4:0:0
10MB201	Cell Biology	4:0:0
10MB202	Microbiology and Immunology	4:0:0
10MB203	Biotechnology Lab – I	0:0:2
10BT301	Advanced Engineering Biochemistry	4:0:0
10BT302	Advanced Biochemical and Bioprocess Engineering	4:0:0
10BT303	Process Equipment Design and Drawing	4:0:0
10BT304	Metabolic Regulations and Engineering	4:0:0
10BT305	Advanced Immunotechnology	4:0:0
10BT306	Industrial Safety Engineering	3:0:0
10BT307	Process Instrumentation, Dynamics and control	3:0:0
10MB301	Nutritional Biochemistry and Physiology	4:0:0
10MB302	Advanced Intermediary Metabolism	4:0:0
10MB303	Medical Microbiology	4:0:0
10MB304	Medical Bioinformatics	3:0:0
10MB305	Molecular Cell Biology	3:0:0
10MB306	Nutritional Biochemistry and Physiology lab	0:0:2
10MB307	Microbiology lab	0:0:2
10MB308	Biomedical Instrumentation	3:0:0
10MB309	Advanced Clinical Biochemistry	4:0:0
10MB310	Advanced Endocrinology	4:0:0
10MB311	Medical Biotechnology	3:0:0
10MB312	Genetic Engineering and Medical ethics	3:0:0
10MB313	Clinical Biochemistry and Experimental Hematology lab	0:0:2
10MB314	Endocrinology lab	0:0:2
10MB315	Immunology and Immunotechnology	4:0:0
10MB316	Clinical Pathology	4:0:0
10MB317	Immunology Lab	0:0:2
10MB318	Medical Lab Technology Lab	0:0:2
10MB319	Neuroscience	3:0:0
10MB320	Medical Lab Technology	3:0:0
10MB321	Complementary and Alternative Medicine	3:0:0
10MB322	Molecular Medicine	3:0:0
10MB323	Cell Culture Techniques	3:0:0
10MB324	Pharmacology and Pharmacognosy	3:0:0

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10MB325	Molecular Biotechnology	4:0:0
10MB326	Molecular Physiology	4:0:0
10MB327	Biomaterials	4:0:0
10MB328	Biological and Biomedical Nanotechnology	4:0:0
10MB329	Biotechnology Lab – II	0:0:2
10MB330	Biotechnology Lab – III	0:0:2

09BT329 MOLECULAR BIOLOGY AND NANOTECHNOLOGY APPLICATIONS IN CELL BIOLOGY

Credit: 4:0:0

Objective:
The aim of this course is to provide knowledge in the applications of molecular aspects and nanotechnology in cell biology.

Outcome: The Student will learn the principle of application of molecular and nanotechniques and its exploitation through cell biology.

Unit I: Cell Culture
Introduction to basic tissue culture techniques, chemically defined and serum free media, animal cell culture, establishment of primary cell culture, maintenance and preservation of various types of culture suspensions, cultures as a source of valuable products.

Unit II : Cell Biology
Structure and functions of cell organelles, Transport mechanisms, Cell signalling, Signal transduction, Different forms of cancers, detection mechanism for cancer using biochemical assay, molecular tools for early diagnosis of cancer, detection and identification of oncogenes.

Unit III: **Molecular Biology And Immunotechnology**
Gene sequencing, Molecular techniques- RAPD, RFLP, AFLP, use of PCR in molecular diagnosis, in-situ hybridization, blotting techniques, immune histochemical analysis, monoclonal and polyclonal antibodies production and application, ELISA, RIA, immune diffusion and immune electrophoresis.

Unit IV: **Nanotechnology**
Introduction and scope of nanotechnology in medicine, types of nanoparticles, Synthesis and characterization of nanoparticles, toxic effects of nanoparticles, application of nanotechnology, nanobiosensors.

Unit V: **Therapy**
Gene therapy, drug delivery system using nanoparticles, ethical issues in nanotechnology, IPR.

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Text Books

1. Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2. Rantner M, Ratner D – "Nanotechnology: A Gentle Introduction to the next Big idea", Prentice Hall, 2003.
3. P Ramadass – Animal Biotechnology "Recent concepts and developments" MJP Publishers.

Reference Books:

1. Macdonal F and Ford CHJ. Molecular biology of cancer. Bios. Scientific publishers, 2002.
2. An introduction to cellular and molecular biology of cancer, J. Oxford Medical Publication, 2008.
3. Viola vogel –" Nanomedicine and Nanotechnology" John willey and Sons Ltd,. 2008.
4. Good Sell – "Nanobiotechnology", John willey and Sons Ltd., Third edition , 2004.

09BT330 CANCER CHEMOTHERAPY

Credit: 4:0:0

Objective

To develop interest and knowledge of students in the area of cancer chemotherapy.

Outcome

At the end of this course, the students would have learnt about basic principles of cancer therapy, screening procedures and current concepts in cervical cancer and therapy.

Unit I: Carcinogenesis

Carcinogenesis: Steps in carcinogenesis. Types and process of carcinogenesis. Physical and chemical carcinogenesis. Various carcinogens present in the environment. Ionizing radiations. Cancer initiation, promotion and progression stages.

Unit II: Food and Cancer

Diet and cancer prevention. Food, Fruits, vegetables and cancer. Role of flavonoids and polyphenols in cancer. Types of cancer in men and women. Environmental factors and causes for different types of cancer.

Unit III: Cancer Therapy

Various types of cancer treatment. Different types of cancer therapy: Surgery, Radiation therapy and chemotherapy. Gene therapy. Role of Drugs in Cancer Treatment – a. Combination chemotherapy, b. Adjuvant chemotherapy. Role of stem cells in cancer.

Unit IV: Cancer Chemotherapy

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General principles of cancer chemotherapy, commonly used cytotoxic drugs, chemotherapy of lung cancer, breast cancer and cervical cancer. Side effects of cancer chemotherapeutic drugs. Chemotherapy induced nausea and vomiting.

Unit V: Cervical Cancer

Cervical cancer. Global incidence and status in India. Causes and Etiology of cervical cancer. Life style. HPV and its role. Types of HPV. Life cycle of HPV.

Cervical cancer therapy. Detection techniques, Screening procedures – types. Awareness of screening procedures in developing and developed countries. Prevention, surgery and chemotherapy in cervical cancer. Role of flavonoids and polyphenols in cervical cancer. Cervical cancer vaccines.

Text Books

1. Stella Pelengaris and Michael Khan; The Molecular Biology of Cancer. Blackwell Publishers, 2006.
2. Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce. The Biological Basis of Cancer. Cambridge University Press, New York 2003.

Reference Books:

1. An Introduction to Cellular and Molecular Biology of Cancer, J Oxford Medical Publications, 2003.
2. Natural Products in medicine: A Biosynthetic approach Wiley 1997.

09BT331 MENTAL HEALTH CARE

Credit: 4:0:0

Objective

To develop skills of students in the area of Mental health care

Outcome

At the end of this course, the students would have learnt about basic principles of Mental health care, Mental disorders, Significance of nutrients and Neurotransmitters and current concepts in herbal therapy.

Unit I : Introduction to Mental health and Classification of mental disorders

Definition and needs of mental health.

Abnormality-Introduction-What is abnormality? Models: Biological: Interpersonel

Classification of mental disorders-DSM-IV-ICD-10

Unit II : Mental disorder and Biological causes

Information about mental illness and brain, Brain function and alteration

Mental stress-Types and causes

Mood disorders-Depression-Major depressive disorders-Types of depression-Biological causes of Depression

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Schizophrenic Disorder –Characteristic and probable causes –Major Subtypes of Schizophrenia-causes-Biological causes of Schizophrenia

Unit III : Neurotransmitters in mental health
Neurotransmitters-Importance and implications. The chemical imbalance in mental health problems Neurotransmitters level and emotional health Dopamine-Serotonin-Nor epinephrine-GABA levels .Short review of Hormonal imbalance in depression

Unit IV : Nutrient role in mental health.Importance of balanced diet – Minerals and their needs-Vitamins and implications- Essential Fatty acids and importance.Nutritional deficiency in depressive and Schizophrenic Disorder

Unit V : Herbal therapy for mental health.Necessity of Herbal therapy in mental health Antidepressive medicinal plants- The vital role of *Hypericum perforatum* Active constituents and functions of *Hypericum perforatum*Successive therapy to heal depression .

Text books:

1. 1.Sarason I.G and Sarason B.R(1998),Abnormal psychology ,The problem of Maladaptive behavior ,eighth edition,Pentile hallof India ,New Delhi
2. 2.Ronoldo.F.Comer (1996),Fundamentals of Abnormal psychology.W.H.Freemann company edition,New Delhi
3. 3.Text book of Integrative medicine for Mental Health care,James Lake-2006

References:

1. 1.The science of mental illness, Teacher's guide,NIMH,2000
2. 2.The chemical imbalance in mental health problems, Joseph M.Carver.P.hd , Monday, 16 February 2009.

09BT332 BIOFUEL CELLS

Credit: 4:0:0

Objective:
To develop interest and knowledge of students in the area of Biofuel cells

Outcome:
At the end of this course, the students would have learnt about basic principles of Biofuel cells and current concepts in Biofuel cells

Unit I : Introduction to Biofuel cells and Biomass
Biofuel cells – A general account – Environmental Impact – Technology aspects of biofuel cells – Biofuel cell classification – Biocatalyst - Second Generation biofuels – Importance of biofuel energy – Potential biomass for fuel generation – Types and composition of biomass – Pretreatment – Biomass feedstocks – Biomass to energy conversion technologies – Energy and fuel using microorganisms

Unit II : Construction of Biofuel cells

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Construction, Operations and Performance of biofuel cells – Proton exchange membrane fuel cell – Nanocomposite membrane – Fabrication of nanofibre and nanowire – Microfabricated fuel cells – Microchips based fuel cell design – Microencapsulation – Enzymatic biofuel cell designs – Nanomaterials in enzymatic fuel cell designs

Unit III : Voltage and Power Generation

Voltage and current – Maximum voltage based on thermodynamic relationships – Anode potentials and enzyme potentials – Voltage generation by fermentative bacteria – Calculating Power – Coulombic and energy efficiency – Polarization and Power density curves

Unit IV : Characterization Techniques

Fundamental Electrochemical Variables: Voltage, Current and Time – Basic fuel cell test station requirements – Electrochemical Impedance Spectroscopy – Current interrupt Measurement – Cyclic Voltammetry - Porosity determination by BET surface area determination – Gas Permeability – Structure Determinations: XRD,SEM,TEM instrumentation and analysis – Chemical Determinations: AES,SIMS,XPS instrumentation and analysis

Unit V : Applications of Biofuel cells

Bioelectricity generation the process of electrogenesis – Energy sustainability of the water infrastructure - Biohydrogen – Waste water treatment – Water desalination – Biosensors – Robots – Renewable energy generation - Biofuels for transportation sector – Biofuel cells in the future

Text Books:

1. Ryan o' Hyre, "Fuel cell fundamentals", ISBN-1397-0-471-74148-0, ISBN-10 0471-74148-5 John wiley & Sons, Inc., Hoboken, New Jersey, 2006
2. Bruce E. Logan, "Microbial fuel cells", ISBN-978-0-470-23948-3 John Wiley & Sons, Inc., Hoboken, New Jersey, 2008
3. Hobart H. Willard, Lynne L. Meritt, John A. Dean, Frank A. Settle, "Instrumental Methods of Analysis", ISBN-81-239-0943-8 Wadsworth Publishing Company, U.S.A, 1986
4. C.Richard Brundle, Charles A. Evans, Jr, Shaun Wilson, "Encyclopaedia of Materials Characterisation", ISBN-0-7506-9168-9 Butterworth Heinemann, a division of Reed Publishing(USA) Inc, 1992

References:

1. T.S. Zhao "Micro Fuel cells Principles and Applications", ISBN: 978-0-12-374713-6, Elsevier's Science & Technology Rights Department in Oxford, UK 2009
2. Allen J. Bard and Larry.R.faulkner, "Electrochemical Methods : Fundamentals and Applications", 2nd Ed., ISBN: 0-471-04372-9, John Wiley & Sons NY, 2001

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3. Zhuwei Du a, Haoran Li a, Tingyue Gu, ”A state of the art review on microbial fuel cells: A promising technology for wastewater treatment and bioenergy”, Biotechnology Advances, 25: 464–482, 2007
4. Sergey Zinoviev, Sivasamy Arumugam, and Stanislav Miertus, ”Biofuel Production Technologies” Area of chemistry, ICS-UNIDO, 2007.

10MB201 CELL BIOLOGY

Credit: 4:0:0

Course Objective:
To study the morphology and functions of the cell and its components and to analyse signalling pathways.
Course Outcome:
The candidates will be familiar with the basics of the cell both prokaryotic and eukaryotic cells and its analysis by molecular techniques.

Unit I: Cells and stem cells
Introduction, Ultrastructure and differences between prokaryotic and eukaryotic cells - Cytoskeleton, Extra-cellular matrix and plasma membrane - Cell organelles and envelopes, self-renewable and regenerating tissues –Stem cells in diseases and therapeutic uses of growth factors

Unit II: Cytoskeleton and cell nucleus
Introduction, Microtubules and associated proteins - Determination of cell shapes - Intermediate filaments - Actin and its associated molecules, Myosin - Cell nucleus: chromatin and chromosomes - Functions of genetic materials in heredity.

Unit III: Cell reproduction and apoptosis
Mitosis and meiosis, role of cyclin dependent kinases – cell cycles- CDKs and Growth control – Apoptosis: common molecular mechanism in diseases - Cell adhesion functional aspects of cell adhesion molecules and its diseases.

Unit IV: Transmission signals
Recognition of extra-cellular stimuli - Transmission of receptor signals to the cell interior: General principles - Control on formation of second messenger molecules, and cell surface ion channels- Sorting in the golgi complex, Cell surface - Regulated endocytosis: receptors for EGF and transferrin –cystic fibrosis.

Unit V: Applications of cell biology
The extra-cellular matrix of animals: Glycosaminoglycans (GAGs) - Cells and organization of collagen fibrils - Elastins and tissue elasticity - Extra-cellular matrix and cell shape during cell proliferation - Integrins as trans-membrane heterodimers - Eggs and Sperm - Germ Cells and Fertilization Primodal germ cells-origin of stem cells, sustainability and regeneration and application.

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Text books:

1. Molecular cell biology, Lodish, Berk, Matsudairia, Kaiser,Krieger, Scott, Zipursky, Darnell, Ed.6, 2008
2. Molecular and Cell Biology, W.D. Stansfield, J.S. Colome, R.J. Cano, McGraw Hill,Ed.5,2003

Reference books:

1. Histology and cell biology, K.E. Johnson, Williams and Wilkins publishers, USA,Ed.2, 1991
2. Cell and molecular biology- concepts and experiments, G. Karp, N.L. Puritt, John Wiley &sons, Ed.6, 2009
3. Molecular and cellular biochemistry, S.L. Wolfe, Wadsworts Inc, California,1999

10MB202 MICROBIOLOGY AND IMMUNOLOGY

Credit: 4:0:0

Objective: To study the basics of microbiology and immunology. This paper will give vast idea of antigens, antibodies and analysis by various immunotechniques.
Outcome: The candidates will have background and can narrow down to their stream of research in immunology and microbiology.

Unit I: General Microbiology

History and scope of microbiology – Classification of microbes and binomial nomenclature Culturing methodology – Sterilization and handling of microbes – Structure and functions of cell wall, cilia and flagella – Structure and function of pili and capsule – Sporulation and microbial nutrition. Light microscopy types and application.

Unit II Application of Microbes

Host- Microbe interaction Microbial diseases- Bacterial- Staphylococcus (MRSA), Pseudomonas (Urinary track Infection), Fungal- Candidiosis, aspergillosis, Viral- HIV, Hepatitis, Protozoan- Amebiosis, Malaria.– Antimicrobial chemotherapy – Source, classification and mode of action of antiboditics – Antimicrobial resistance – Tests for sensitivity to antimicrobial agents –SCP- Wine and ethanol production.

Unit III: Outlines of immunology

Overview of immune system, Innate and Acquired immunity – Humoral and Cell mediated immunity – Organs and cells involved in immune responses – Hemopoitic stem cells- APC.

Unit IV: Antigens, antibodies and complements

Types of antigens and its characteristics, Activation and maturation of lymphocytes and monocytes, Antibody synthesis, clonal selection (Monoclonal, Poly clonal) – Antibody specificity – Antigen specific receptor of antibodies – Structure and functions of immunoglobulins –Complement system.

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Unit V: Immune System

Antibody synthesis, clonal selection - Primary and secondary interactions of antigens and antibodies- Immune disorders and Autoimmunity – Major Histo-compatibility complexes – Immunodeficiency and immunotherapy – Hypersensitivity — Immunological techniques: RIA, ELISA, Immunocytochemistry, Immunoblotting, Fluorescence antibody technique.

Text books:

1. Microbiology, Pelczar MJ, Chan ECS, and Krein NR, Tata McGraw Hill, New Delhi, India, Ed.7, 2010
2. Foundations in microbiology, K.Talaron, A.Casita, and Reid, W.C. Brown publishers, Ed.3,1996
3. Essential immunology, Ivian Roitt, Ed. 8, Blackwell Scientifics, Ed.11
4. Immunology, D.M. Weir and J. Stewart, Ed. 8, Churchill Livingston, New York, Ed.8, 1997

Reference

1. Cellular and molecular immunology, A.K. Abbas, A.K. Lichtman, J.S. Pober, Ed. 3, W.B. Saunders Co., Ed.4, 2001
2. Molecular biology of the cell, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D Watson, Ed. 3, Garland pubs. Inc., New York, 1994
3. A Text book of biotechnology, B.N. Prasad, Budha academic enterprises, Kathmandu, Nepal, 2003
4. World of microbiology and immunology, Brigham Narins, Thomas Gale publishers, 2007

10MB203 BIOTECHNOLOGY LAB-I

Credit : 0:0:2

12 experiments will be notified by the HoD from time to time

10BT301 ADVANCED ENGINEERING BIOCHEMISTRY

Credit: 4:0:0

Objective

To enable the students to understand the various metabolic pathway and cell signaling

Outcome

The students will be familiar in transport mechanism and various metabolic pathways and their significance

Unit I :Complex Carbohydrate and Regulation of Carbohydrate Metabolism

Complex Carbohydrates-Structure, properties and function of proteoglycan, glycosaminoglycan, glycoprotein, glycolipids and lipopolysaccarides, Structural and functional relationships in complex carbohydrates and their role in cell-cell interaction, blood grouping, cell signaling, recognition markers and cell-cell adhesion., Interlinkage of

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metabolic pathways- Krebs bicycle, Ketone bodies production and their role. Regulation of carbohydrate metabolism-catabolism and anabolism in animals.

Unit II: Proteins

Characterization and Structural elucidation of proteins, methods of protein extraction, separation, isolation, purification and quantification. Proteolytic activation and protein sequencing, Homologous proteins. Conjugated proteins-Myoglobin, haemoglobin and lysozyme. Protein targeting in eukaryotes and prokaryotes- glycosylation, protein folding and chaperons. Structural and functional relationships in proteins.

Unit III: Lipids

Lipid digestion, mobilization, transport and storage. Lipid extraction, separation and structural analysis. Lipids with specific biological activities- phosphoinositides, steroid hormones, eicosanoids, quinones, dolichols and fat soluble vitamins. Biosynthesis of membrane phospholipids, plasmalogen, triacyl glycerol, glycerophospholipids and eicosanoids. Desaturation of fatty acids.

Unit IV: Enzymes and Co-enzymes

Enzyme catalysis, Characteristics and 3 D structure of enzymes, Zymogen activation. Co-enzymes-role of vitamins as co-enzymes-B-complex, co-factors and prosthetic groups. Antioxidant enzymes and its physiological role-SOD, hydrogen peroxidase, glutathione reductase, glucose 6 phosphate dehydrogenase.

Unit V: Hormone and its mechanism of action

Structure, physiological role and mechaninsm of action of Hormones that bind to intracellular receptors- androgens, thyroid hormones, estrogens, glucocorticoids, mineralocorticoids and Hormones that bind to cell surface receptors-FSH, somatostatin,glucagon, luteinizing hormone, parathyroid hormone.

Text Books

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.

Reference Books

1. Harper's Biochemistry – (2000), Robert K., Md Murray,Daryl K. Granner,Peter A. Mayes, Victor W. Rodwell,Appleton and Lange, Robert K. Murray
2. Donald Voet and Judith G. Voet .Biochemistry – Volume 1 Biomolecules, Mechanisms of Enzyme Action, & Metabolism; 2004.
3. A Text Book of Biotechnology by B. N. Prasad (2003), Budha Academic Publishers Pv.Ltd.G. P.O.Box 20195 Kathmandu,Nepal .
4. Jain and Jain (2008). Biochemistry, Chand publication
5. 5.Biochemistry by Rawn,Panima Publications, NewDelhi, (2005).

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10BT302 ADVANCED BIOCHEMICAL & BIOPROCESS ENGINEERING

Credit:4:0:0

Objective
To acquire the knowledge about the various biochemical reactions and the ways to alter the biochemical pathways.

Outcome
At the end of the course the student will be familiar in fermentation process and metabolic stoichiometry and the way to enhance the product of interest.

Unit I Transport phenomena in bioreactors
Mass transfer in heterogeneous biochemical reaction system: Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer coefficients (kla); role of aeration and agitation in oxygen transfer. Heat transfer processes in biological system.

Unit- II Data Analysis in bioprocess
Collection and analysis of data on bioprocess engineering, mass and energy balances for steady state and unsteady state biochemical systems; Fluid flow and mixing; mass transfer in biological systems

Unit- III Reaction Kinetics in bioprocess
Reaction kinetics for biological systems- M.M kinetics, enzyme deactivation kinetics; heterogenous reactions in bioprocessing- concentration gradients and reaction rates in solid catalysts, internal mass transfer in heterogenous reactions; Thiele modules - solid – liquid mass transfer correlations, minimizing mass transfer effects.

Unit - IV Process design and operation of Bioreactors
Operational modes of reactors – batch, continuous, fed batch, repetitive batch, recycle and continuous cultivation; novel bioreactors: Stirred tank, air lift and loop reactor, packed – bed and hollow – fibre membrane bioreactors; reactors for waste – treatment processes; scale- up criteria for bioreactors.

Unit- V Process Control
Online data analysis of physico chemical parameter measurements for biochemical processes; Concepts of process control- Application of Artificial Intelligence, Fuzzy logic and neural networks in bioprocess control, Case studies on bioreactor control problems, PIPIB Controllers, GLP, GMP Practicers, TQ, IQ protocols.

Text Books:

1. Shuler and Kargi, Bioprocess engineering, Prentice Hall, Second Indian Reprint (2004).

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2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology,* Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References:

1. Atkinson, B. & Mavituna . F., Biochemical Engineering and Biotechnology Handbook, McGraw Hill (2nd Edition) (1993).
2. Bailey J.E. and Ollis, D.F. Biochemical Engineering Fundamentals, McGraw Hill, (1986).
3. Bioprocess Engineering Principles – Pauline M Doran, Academic Press, 1995.
4. Biochemical Engineering by James M.Lee , Prentice Hall 1992
5. Bioreactor Design and Product Yield , Biotol Series, Butterworth – Heinemann; 1993.

10BT303 PROCESS EQUIPMENT DESIGN AND DRAWING

Credit: 4:0:0

Objective:
To design safe and dependable processing facilities in a cost effective manner. This course focus on plant layout and design of piping systems.

Outcome:
At the end of the course the student will be familiar in design and engineering principles involved in process plant layout and piping design.

Unit I: Engineering Properties
Introduction to various mechanical properties of materials to be used as material of construction, resistance of metals to corrosion under varying conditions of temperature and pressure etc. Factor of safety - Working stresses. Application and use of various codes and standards in design. Piping and Instrumentation Diagrams.

Unit II: Storage Tanks
Design of non-pressure storage vessel, tall vertical vessels, unfired pressure vessels with internal pressure, Design of unfired pressure vessels with external pressures,

Unit III: Design of Fermentor & Separation Equipment
Design of batch, fed batch, continuous and airlift Fermentor. Design of Centrifuge, Filtration Equipment and Crystallizers.

Unit IV: Heat Transfer Equipments
Detailed design and drawing of heat exchangers (shell & tube, exchanger). Condensers, evaporator, reboilers & related equipment.

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Unit V: Mass Transfer Equipments
Detailed design and drawing of Distillation columns, dryers –rotary dryers and tray dryers and extractors.

Text Books:

1. Peters Max. S., Timmerhaus Klaus D.and Ronald E West "Plant Design and Economics for Chemical Engineers".2003 V Edition McGraw Hill.
2. Indian Standard Codes:
   (a) IS : 2825 - 1969: Code for Unfired Pressure Vessels.
   (b) IS : 4049 - 1979: Specifications for formed ends for Tanks and Pressure vessels.
   (c) IS : 4179 - 1967: Sizes of Process Vessels & their Leading Dimensions.
   (d) IS: 4864 to 4870 - 1968: Specifications for Shell Flanges for Vessels and Equipment.
   (e) IS : 4503 - 1967: Specifications for Shell & Tube Heat Exchangers.
   (f) IS : 803 - 1962: Code of practice for Design, Fabrication and Erection of Mild Steel Cylindrical Welded Oil Storage Tanks. (Published by Bureau of Indian Standards, New Delhi).

References:

1. Brownell, L.E, & Young, E.H.: Process Equipment Design, Wiley Eastern, New Delhi, (2000).
2. 2. Ludwig, E.E.: Applied Process Design for Chemical & Petrochemical Plants, Vols. I, II & III, (2nd Ed.), Gulf Publishing Company, Texas, (1977, 1979, 1983).
3. Strigle, R.F.: Random Packings & Packed Towers (Design & Application), Gulf Publishing Company, Texas, (2000).
4. Perry, R.H. & Green, D.W.: Perry's Chemical Engineers' Handbook, (7th Ed.), McGraw Hill (ISE), (2000).

10BT304 METABOLIC REGULATIONS AND ENGINEERING

Credit: 4:0:0

Objectives

The paper aims to give the students the different methods of metabolic regulations, different methods of synthesis of primary and secondary methods and different methods of bioconversion that can be used in industry.

Outcome

At the end of the course, the students would have learnt about metabolic regulation and various methods of synthesis of primary and secondary metabolites and bioconversion.

Unit I: Introduction to Metabolic Engineering:
Basic concepts of Metabolic Engineering – Overview of cellular metabolism: Metabolic flux integration of anabolism and catabolism, Limiting accumulation of end products. Strain

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selection, Genetic improvement of strains, repressor mutants, recognizing growth cycle peak, factors influencing growth cycle peak, gene dosage.

Unit II: Regulation of Gene Expression and Metabolic Pathways:
Regulation of gene expression in prokaryotes -Lac operon, Regulation of gene expression in eukaryotes, Regulation of RNA synthesis by amino acid, RNA based metabolic regulation-microRNA's. Feedback regulation, regulation in branched pathways- differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, Alteration of feed back regulation, permeability control: passive diffusion, active transport, group translocation.

Unit III: Regulation of Primary Metabolites and Enzymes:
Producers of primary metabolites, Metabolic pathways and regulation of production processes- amino acids (Tryptophan, glutamic acid, aspartic acid, lysine and phenylalanine), organic acids (citric acids, lactic acid, acetic acid), alcohol (Ethanol), Enzymes- protease, amylase, cellulase, lipase.

Unit IV: Regulation of Secondary Metabolites:
Producers of secondary metabolites, Metabolic pathways and regulation of production processes- antibiotics (penicillin, cephalosporin, erythromycin, streptomycin), Vitamins (Vit B_{12}, Vit B_2, Vit A, Riboflavin), Mycotoxins, Steroids; precursor effects, trophophase-idiophase relationship, applications of secondary metabolites, Mutants resistant to repression

Unit V: Regulations of Bioconversions:
Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances, Applications of Bioconversions in food industry, agriculture; Applications of Metabolic Engineering- pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion.

Text Books:

1. W. Crueger and A.Crueger, Biotechnology- A Text Book of Industrial Microbiology
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology*, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005

References Books:

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D., " Fermentation And Enzyme Technology ", John Wiley And Sons., 1980.
2. Zubay G., "Biochemistry ", Macmillan Publishers, 1989.
3. David Friefelder, Molecular Biology, Narosa Publ. House. 1999

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10BT305 ADVANCED IMMUNOTECHNOLOGY

Credit: 4:0:0

Objective
This course aims to develop the skills of the students in Immunotechnology, antigen antibody response, immunodiagonosis, immunopathology etc.
Outcome
At the end of the course would have learnt about the mechanisms by which a human body interacts with a pathogenic microbe & how it eliminates it. Students, also familiarize themselves with immunopathology and immunotherapy.

Unit I: Basics of Immunotechnology
Antigens: Types of antigen, their structure; preparation of antigens for raising antibodies: peptide antigens and their preparation; handling of animals; adjuvants, viral coat proteins as recombinant adjuvants and their mode of action.

Unit II: Antibodies and Immunodiagnosis
Recombinant monoclonal and polyclonal antibodies – their production, characterization and applications; Western Blot analysis, Immunoeletrophoresis, Applications of ELISA and Radio Immuno Assay (RIA) in immunodiagnosis; chemiluminescence assay, phage display.

Unit III: Techniques to assay Cell Mediated Immunity
Identification of lymphocytes and their subsets in blood, T-cell activation parameters, estimation of cytokines, macrophages activation, macrophage microbicidal assays; cytotoxicity assay; helper T- cell assay; Applications of cytotoxic T- cell assay in cell mediated immune response.

Unit IV: Immunopathology
Preparation of storage of tissues, identification of antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, Immunohistochemistry, immunoenzymatic and immunoferrtin techniques for disease diagnosis; ELISPOT assay.

Unit V: Molecular Immunology
Recombinant vaccines, application of recombinant DNA technology for the study of the immune system; production anti idiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies, immunotherapy.

Text Books:
1. Talwar G. P., and Gupta S.K., A Hand book of Practical and Clinical Immunology, Vol. 1 & 2, CBS Publications, 2004.

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2. Chakravarthy AK. Immunology & Immunotechnology. Oxford University Publishers. 2nd Ed. 2009.

Reference Books:

1. Gosling JP, Reen DJ. Immunotechnology. Portland Press Ltd. UK. 6th Ed. 2009
2. Pandian. Immunology and Immunotechnology. Panima Publishers. 2nd Ed.2009.
3. Antibody Laboratory Manual by Ed Harlow, Cold Spring Harbor, NewYork,1988.

10BT306 INDUSTRIAL SAFETY ENGINEERING

Credit: 3:0:0

Objectives:

To develop highly qualified professional manpower the basic requirement lies on Systematic quality based coaching and training in Advanced Science and Technologies.

Outcome:

At the end of the course the student will be familiar in safety program in terms of effectiveness to improve safe work practices and good housekeeping, and the effect of mode of administration upon program effectiveness.

Unit I: Introduction

Major industrial accidents in India and in other countries-case studies of the accidents; in Bhopal (India), Flixborough in UK, Seveso in Italy.

Unit II: Industrial Safety

High pressure-high temperature operation- dangerous and toxic chemicals - highly radioactive materials-safe handling and operation of materials and machineries-planning layout-safety slogans.

Unit III: Safety Performance

Work environment-noise-effect of noise-unit of sound-noise levels in industries-control of noise-lighting-intensity of light for various operations in industry-measurement of intensity of light-industrial illumination-requirements for good lighting-industrial ventilation and exhaust systems.

Unit IV: Accidents

Identification and analysis of causes of injury to men and machineries-accident prevention-accident proneness-vocational guidance, fire prevention and fire protection-personal protective equipments.

Unit V: Health Hazard

Health hazard–occupational-industrial health hazards –health standards and rules-safe working environments.

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Role of Government, safety organization, management and trade unions in promoting industrial safety- on site and off site safety provisions.

Note: **Industrial Visit: Report – Mandatory**

Text Book:

1. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)

Reference Books:

1. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)
2. Safety Management in Industry, Krishnan, Jaico Publishers, New Delhi.
3. Safety and Accident Prevention in Chemical Operations, H.H. Fawcet and W.S. Wood
4. Occupational Safety and Health Management, Anton, McGraw Hill Co., New York(2000)

10BT307 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

Credit: 3:0:0

Objectives:

The fundamental background for understanding and controlling the dynamics of chemical processes. Through it the students acquire the ability to apply mathematical and computational tools and engineering knowledge to formulate and solve process dynamics problems and to design appropriate control schemes to regulate the processes.

Outcome:

At the end of the course the student will be familiar in process parameters and the effectiveness of controller designs.

Unit- I: Open Loop Systems

Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics.

Unit II: Closed Loop Systems

Closed loop control systems, development of blsock diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

Unit III: Frequency Response

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Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

Unit IV: Advanced Control Systems -I
Introduction to advanced control systems, cascade control, feed forward control, model predictive control.

Unit- V: Advanced Control Systems-II
Control of distillation towers and heat exchangers, introduction to computer control of Biochemical processes.

Text Books:

1. Stephanopoulos, G.,"Chemical Process Control ", Prentice Hall of India, 2003.
2. Sundaram,S. "Process Dynamics and Control", Ahuja Publishers, New Delhi, 2002

References:

1. Marlin, T. E., "Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", John Wiley, New York, 2000.
3. Coughnowr, D., "Process Systems Analysis and Control ", McGraw Hill,New York, 2000

10MB301 NUTRITIONAL BIOCHEMISTRY AND PHYSIOLOGY

Credits: 4:0:0

Objective
To impart the knowledge on Historical overview of Nutrition, essential nutrients for metabolism, overall metabolism of ingested nutrients, factors influencing metabolism of nutrients and nutritional biochemistry.

Outcome
At the end of the course, the students would have learnt about the correlation between nutrition and physiology.

Unit I: Nutrition and its physiological role (12)
Definition for nutrition, nutrients, body weight body composition, measurement of energy expenditure – calorimeter, BMR, SDA and RQ. Physico chemical properties and physiological actions of Dietary fibre protein energy malnutrition.

Unit II: Vitamins and Minerals (13)
Outlines of vitamins and minerals. Classification of vitamins – Fat soluble and water soluble. Dietary source, structures, RDA, functions and deficiency states. Macro and micro elements – Dietary source, structures, RDA, functions and deficiency ststes. Macro and micro

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elements_ Dietary sources, structures, RDA function and deficiency of Iron, Calcium, phosphorus and magnesium, Iodine, zinc and copper. Dietary requirement in pregnancy, lactation, infants children and adolescent.

Unit III: Metabolic Disorders and its Dietary Management (13)
Dietary management with special reference to Diabetes mellitus, obesity. Cardiovascular diseases, diseases associated with liver, kidney, gastric (peptic ulcer), intestine (Steatorhoea) and Cancer, Water and electrolyte balance and regulation. Acid base balance: regulation, acidosis and alkalosis.

Unit IV: Anatomy (12)
Overview of Anatomy – medical and anatomical terminology – sections of the body – anatomical variations – diagnostic imaging, introduction to systemic anatomy – types of bone – joints – classification of joints – innervations of joints – muscle tissue and muscular system – types of muscle – blood vessels and cardiovascular system – lymph and lymphatic system – functions of the lymphatics.

Unit V: Circulatory system and its physiological role (15)
Circulatory system – composition and functions of plasma, blood coagulation, transfer of blood gases. Respiratory system components and their function – transport of oxygen and carbondioxide. Digestive system – composition and functions: Digestion and absorption of carbohydrates, lipids, proteins etc., Excretory system – structure of nephron, formation of urine, tubular reabsorption and secretion: Nervous system – organization, nerve impulses and neurotransmission, action potential, visual auditory pathway. Structure and functions of Reproductive system. Physiology of pregnancy and lactation.

Text Book:

1. Martin Eastwood,' Principles of Human Nutrition' Blackwell publishing, II edition (2003).

Reference Book:

1. Chandi Charan Chatterjee, 'Human Physiology' Volume I, Medical Allied Agency, XI edition (1994).

10MB302 ADVANCED INTERMEDIARY METABOLISM

Credits: 4:0:0

Objective:
To learn the metabolism and integration of biomolecules that takes place in human system. Integrate the various aspects of metabolism & their regulatory pathways.

Out Come:
Students would learn the metabolism of biomolecules and their metabolic relationships (integrated metabolism).

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Unit I: Metabolism Of Carbohydrates

Carbohydrate metabolism - general view; glycolysis - reactions, intermediates, enzymes and coenzymes in glycolysis; coupling of glycolysis with other pathways. Glycolysis in erythrocytes, alcoholic fermentation. Gluconeogenesis - reactions, enzymes, coenzymes; bypasses. Pentose phosphate pathway - reactions, enzymes, major functions. Metabolism of glycogen - lycogenesis and glycogenolysis, regulation of the processes. Uronic acid pathway - the role and function; metabolism of galactose and fructose; metabolism of aminosugars. Disorders in glucose metabolism; galactosemia,pentosuria, fructosuria, glycogenesis

Unit II: Metabolism Of Lipids

The role of lipids in the organism; Fat digestion, absorption and transport; mobilization of stored fat; lipoproteins. Cellular metabolism of lipids as a basic source of energy; fatty acid oxidation - localization; b-oxidation - steps, enzymes, coenzymes, metabolite; b-oxidation of odd numbered FA and unsaturated FA; oxidation of FA and ATP production; ketogenesis and ketones bodies

Biosynthesis of FA; localization and main steps, the role of malonyl-CoA and acetyl-CoA, FA synthase complex; reducing equivalents (NADPH) in biosynthesis; elongation of FA chain; biosynthesis of unsaturated FA Metabolism of prostaglandins , Biosynthesis of cholesterol and its role in organism.Bile acids and salts, steroid hormones biosynthesis. Synthesis of vitamin D from cholesterol. disorders in fatty acids metabolism; ketonemia, ketonuria, lipid myopatia;atherosclerosis

Unit III: Metabolism Of Proteins, And Amino Acids

Nitrogen balance (positive, negative); intracellular degradation of proteins, amino acids (essential, nonessential); transamination, oxidative deamination, decarboxylation, NH3 formation - the urea cycle reactions; catabolism of carbon skeletons of amino acids; glycogenic and ketogenic amino acids; disorders in amino acid metabolism. Metabolic transformation of individual amino acids. Synthesis of nonessential amino acids.

Unit IV: Metabolism Of Nucleic Acids

Metabolism of nucleotides - purine and pyrimidine synthesis; catabolic reaction of purines and pyrimidines - metabolic disorders (gout, Lesh-Nyhan syndrome, hyper- and hypo-uricemias, urolithiasis). Regulation of nucleotide production, synthesis of deoxyribonucleotides. Inhibitors of purine and pyrimidine biosynthesis. Salvage pathways. Nucleic acids and proteosynthesis - replication and transcription of DNA; biosynthesis of tRNA, mRNA, rRNA; regulation and inhibition of proteosynthesis. Inhibitors of proteosynthesis**.**

Unit V: Metabolic Interrelationships & Regulatory Mechanisms

Metabolism of Hemoglobin, metabolic control, energy production & regulation. Specificity of metabolism of the RBC; Biosynthesis and degradation of heme and molecular disorders (porphyria, hyperbilirubinemia ...);Metabolic changes during starvation, Macro & micro – elements & their role in health & disease, water metabolism & its regulation. Xenobiotics

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and their biotransformations, the role of liver cells in detoxification of xenobiotics, types of basic biotransformation reactions.

Text Books:

1) Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes &V.W.Rodwell, 2009, The Mc Graw-Hill Company, Inc.
2) Textbook Of Medical Biochemistry ,M.N Chatterjee, Rana Shinde, 6th Edition, Jaypee publishers, 2006.

Reference books:

1) Biochemistry- J.M.Berg, J.L.Tymocko and L.Stryer, Freeman and Co, VI edition, 2003.
2) 2)Principles of Biochemistry . Ed. Lehninger , Nelson & Cox .CBS publishers & distributers, VI edition, 2003.
3) Biochemistry- D.Voet and J.G.Voet, John Willey and Sons, III edition, 2004.
4) Principles of Biochemistry- H.R.Horton, L.A.Moran and G.Scrimgeour, D.Perry, D.Rawn, Prent Hall, VI edition, 2007.
5) Out lines of Biochemistry- E.E.Conn, P.K.Stumph, G.Bruening and R.H.Doi, John Willey Sons, V edition, 2006.

10MB303 MEDICAL MICROBIOLOGY

Credits: 4:0:0

Objectives:

This course will focus on mechanisms of microbial pathogenesis and the host response. To learn the scientific approaches that are used to investigate these processes such as how do microbial pathogens modulate host cells to expedite virulence, how do host cells respond to microbial pathogens

Outcome:

At the end of this course students will be able to compare and contrast different microbial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis. Also to compare and contrast therapeutic treatments for microbial infections, and distinguish when a vaccine, antibiotic, or other therapy is likely to be the most appropriate response.

Unit I: Bacteriology

Normal microbial flora of human body, host-microbe interactions. Infection and infectious process routes of transmission of microbes in the body. Cultural characteristics, Biochemical reactions, mode of transmission, Antigenic structure, pathogenicity, Lab diagnosis, treatment and control measures of diseases caused by Staphylococcus aureus, Streptococcus, Clostridium tetani, Corynebacterium diphtheria, Bacillus anthrax, Mycobacterium tuberculosis, Enterobacteiaceae- E.coli, Klebsiella pneumoniae, Salmonella typhi, Shigella, Pseudomonas aeruginosa, Proteus, Vibrio cholera, Haemophilus influenza, Treponema pallidum, Chlamydia and Mycoplasma

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Unit II: Medical Mycology

Medical Mycology – Culture characteristics, Biochemical reactions, Mode of transmission, Antigenic structure, pathogenicity, Lab diagnosis, treatment and control measures of diseases caused by Cutaneousmycosis – Dermatophytosis, opportunistic mycosis – Candidiasis, Subcutaneousmycosis – mycetoma, Systemic Mycosis – Histoplasmosis, Superficial mycosis – Tinea, Pidia

Unit -III: Parasitology

Parasitology – Morphology, Mode of transmission, Antigenic structure, pathogenicity, Lab diagnosis, treatment and control measures of diseases caused by Coccidian – Toxoplasma, Cryptosporidium, Helminthes, taenia solium, Fasiola hepatica, Ascaris lumbricoides, Trypanasoma, Giardiasis, Amoebic dysentery, Mode of action of anti- protozoan agents. Principles of chemotherapy, Mode of antibiotics: Penicillin, Streptomycin, Sulfonamides, and Polymyxins Antifungal drugs (Nystatin), Antiviral agents. Problems of drug resistance and drug sensitivity, Drug resistance in bacteria.

Unit IV: Molecular Virology

Animal viruses, infection on host, Oncogenic viruses (tumor viruses) DNA containing oncogenic viruses, human adenovirus, RNA containing oncogenic viruses, retroviruses (Onco RNA viruses), AIDS virus, Hepatitis viruses. Bacterial phages & viruses - Structure and replication of RNA and DNA bacteriophages, X 174 phages, lambda phage, lytic and lysogenic cycle. Antiviral agents - chemical and biological agents - Interferon - Nomenclature, types and classification. Induction of interferon, types of inducers.

Unit V: Virology (12)

Viral diseases: Description and pathology of diseases caused by pox viruses; herpes virus (Chicken Poxzoster); myxo and paramyxo viruses; adenovirus, other respiratory viruses, viruses affecting nervous system, enterovirus, reovirus, viral hepatitis, HIV virus. Emerging viral diseases like Chicken Guinea virus, Dengue virus, H1N1 virus and Japanese Encephalitis virus

Text Books

1. Ananthanarayan. R. And Paniker C.K. Text Book of Microbiology, Orient Longman, 2004
2. Murray, P.R., K.S. Rosenthal, and M.A. Pfaller. 2005. Medical Microbiology, 6th edit. Elsevier-Mosby

Reference Books

1. Textbook of Diagnostic Microbiology, by Connie R. Mahon, Donald C. Lehman and George Manuselis, 3rd edition. 2007.
2. Subash Chandra Parija, Textbook of Medical Parasitology, All India Publishers & Distributors, 2004
3. Jagdish Chander, Text Book of Medical Mycology, Interprint / Mehta Publishers, 1995.
4. White David O, Fenner, Medical Virology, Academic Press, 1994.

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10MB304 MEDICAL BIOINFORMATICS

Credits: 3:0:0

Objective:

The objectives of this study are to determine, and to better understand, elements that are common across a range of bio-health information resources; and to characterize those resources in terms of search and display functionality. Our ultimate goal is to better define the role of bio-health information in clinical practice and in biological research.

Outcome:

Students will learn the computer-generated models that indicate the presence of a disease or the relative impact of a particular treatment. These models may point to an underlying genomic or proteomic cause, for which genomic or proteomic testing or therapies could then be applied for confirmation and/or treatment.

Unit I: Biomedical Systems

Coding -Common health care language - coding techniques – coded and quasi coded data Medical vocabulary – industry wide communication standards HL7 – unified medical language system – quality of care paradigms, risk management bioethics.

Unit II: Biological Information

Information networks - Internet – facilities used in the internet web browsers STTP 5,HTTP, HTML, URL – European molecular biology network – national centre for biotechnology information.

Unit III: Bioclinical Transcription

Patient record maintenance - Electronic patient record – models or ERP –environmental services – metrics – telemedicine – community networks –telemedicine peripherals and equipment selection – anatomy of video conferencing technology.

Unit IV: Cell And Molecular Bioinformatics

Basic Genetic Science : Study of cell, nucleus, chromosomes and their components Evaluation of chromosomes, Impact of chromosomes on genes, gene study. Protein information resources - Biological data basics – primary secondary data basics – Protein pattern data basics – DNA sequences data basics - DNA analysis - Genes structure and DNA sequences – interpretation of EST structures – different approach to EST analysis.

Unit V: Clinical Data Analysis (11)

Alignment techniques **–** BLAST, CLUSTA, N.P Data base searching - comparison of two sequences– identity and similarity – global and global similarity – global and local alignment- multiple sequence alignment – data basis of multiple alignment – secondary data base. Expert system-Principles of expert system – phylogenetic tree construction - integration of decision support in clinical processors.

Text Book

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1. T.K. Attwood, D.J. Parry-Smith, "Introduction to Bioinformatics", Pearson Education, 1999

Reference Books

1. Coiera E, "Guide to medical informatics, The internet and telemedicine, Chajsman & Hall medical", London 1997.
2. Bernser, E.S., " Clinical decision support systems, Theory and practice, Springer-Verlag", New York, 1999.
3. Dan E. Krane , Michael L., Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education, 2002.

10MB305 MOLECULAR CELL BIOLOGY

Credits: 3:0:0

Objectives:

Molecular and Cellular Biology (MCB) to be an authoritative source of fundamental knowledge and new developments in all aspects of the molecular biology of eukaryotic cells and prokaryotic cells.

Outcome:

Students can understand about the microbial as well as higher organisms and on viral systems where the emphasis is clearly on the cell, including gene expression, chromosome structure and dynamics, signal transduction, intracellular trafficking, and mammalian genetic models.

Unit I: Basics and Functions of the Cells

Cell structure of archae and eubacteria, eukaryotes. Single cell to multicellular organisms, continuous and synchronous cell culture, cell fractionation. Experimental models: *E.coli*, yeast, slime mold, *C.elegans*, Drosophila and Arabidopsis thaliana.

Unit II: Cellmembrane and Transport System

Molecular organization of cell: plasma membrane, lipid bilayer, membrane proteins, carbohydrates, transport of small and macro molecules-ectocytosis, endocytosis, cytosol, ribosomes, rough and smooth endoplasmic reticulum, Golgi, lysosomes and protein sorting and transporting.

Unit III: Metabolisms of Cell Organelles

Mitochondria-origin, evolution, structure, chemosmotic theory, electron transport chain, electrochemical protein gradient, respiratory chain, redox potential; chloroplast: origin and evolution, structure, light absorption and conversion of CO_2 to carbohydrate, carbon fixation, metabolic exchange by chloroplast membrane.

Unit IV: Functional Aspects of Cell Division

Nucleus, Nuclear envelope, cell cycle, cell growth and division, control of cell division, events in phases: G_1, S, G_2, M. Cytoskeleton and cell movement.

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Unit V: Cell Cycle and Cancer Regulations

Concept of oncogenes; neoplastic cell growth; tumour suppressor genes and their role in cell cycle. Si RNA and its role in gene therapy.

Text Book

1. DeRobertis EDP and DeRobertis EMF Jr. (2004) Cell and Molecular Biology, 8th edition, Lippincott Williams & Wilkins, Philadelphia, USA.

Reference Books

1. Cooper GM (2000) The Cell: A Molecular Approach. (2nd edition), ASM Press, Washington, USA
2. Lewin B (2004), Genes VIII, Pearson Prentice Hall, New Jersey, USA.

10MB306 NUTRITIONAL BIOCHEMISTRY AND PHYSIOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time.

10MB307 MICROBIOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time.

10MB308 BIOMEDICAL INSTRUMENTATION

Credits: 3:0:0

Objective: To learn about the various medical instruments and latest techniques used in the hospital for diagnostic purpose

Outcome: Students are expected to be thorough with latest biomedical instruments and their handling techniques

Unit I: Biomedical Equipments

Classification of biomedical equipment. Diagnostic, therapeutic and clinical equipment, bioelectric signals and their recording, Bioelectric signals (ECG, EMG and EEG) and their characteristics, bioelectrode – types, electrode tissue interface, contact impedance, electrodes for ECG, EMG, EEG.

Transducers for biomedical application, Types, characteristics and selection of transducers for biomedical instrumentation.

Unit II: Therapeutic Components

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Biosensor – Mechanism and types. Autoanalyser – types and application, Automatic tissue processing and application of microtome. Pulse oximetry – introduction, Principle and application of Sphygmomanometer.
Magnetic resonance imaging system, Basic NMR components and its application in medicine.

Unit III: Scanning Techniques
X-ray machine, radiography, fluoroscopy, Conventional X- ray imaging, angiography, computer tomography and linear tomography, Ultra sonic imaging system, Physics of ultra sonic waves, medical ultrasound, different mode of operation of ultrasound – A scan, B scan, application of ultra sound scan, CT scan, MRI scan and echocardiography.

Unit IV: Laser Techniques
Introduction, Characteristics, diagnostics and therapeutic application and advantage of pulsed ray laser, ND- YAG scan, CO2 laser, argon laser and helium neon laser. Introduction, types, merits, demerits, limitations, diagnostic, therapeutic application of endoscope, Laproscope and cardioscope.

Unit V: Therapeutic Instruments
Therapeutic instruments – Introduction, types, life time, classification, power source and electrodes of cardiac pacemaker and defibrillators. Application of surgical diathermy equipment and haemodialysis in medicine.Computer application in medicine – computerized catheterization laboratory – computerized patient monitoring system.

Text books:
1. Handbook of medical instruments by R.S.Khandpur,2007
2. Biomedical Instrumentation by Cromwell, 2009

Reference Books:
1. Principles of applied Biomedical instrumentation by Goddes and Baker –John Wiley, 2002.
2. Biomedical instrumentation and measurement by Carr and Brown Pearson, 2001

10MB309 ADVANCED CLINICAL BIOCHEMISTRY

Credits: 4:0:0

Objectives
To interpret biochemical diagnostic assays, disease state, metabolic functions. Identify biochemical diagnostic agents or tests useful in: diagnosis and monitoring response to therapy.

Outcome
At the end of the course students will be well versed in the medical terminology, techniques and acquire knowledge on diseases and disorders.

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Unit I: Specimen Collection and Processing

Collection of blood vein puncture, collection with syringe, collection with evacuated tube, skin puncture, arterial puncture and anticoagulants.

Collection of urine:-Timed urine specimens, urine preservatives. Test for urinary compounds. Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins.

CSF:- Composition and collection ,chemical examination and infections, spinal cord infections. **Amniotic fluid:-** Origin, collection, composition and analysis of amniotic fluid.

Unit II: Serology and Hematology

C- reactive protein test, immunological test for pregnancy. Rhumatoid arthritis (RA) test. ESR., Coagulation test, prothrombin test.

Hemoglobin: Normal and abnormal Hb, Seperation of hemoglobin. Thalasemia, Hemoglobinopathies. Erythrocyte metabolic pathways, Disorder of erythrocyte metabolic pathways, erythrocyte enzyme disorders. Porphyrins and porphyrias.

Unit III: Clinical Enzymology Principles of Diagnostic Enzymology

Factors affecting enzyme levels in blood. Principle, assay, and clinical significance of transaminases, creatine kinase, lactate Dehydrogenase, phosphatases, isocitrate dehydrogenase, 5'nuclotidase, gamma –glutamyl transferase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose -6-phosphate dehydrogenase and ceruloplasmin.

Enzyme pattern in diseases:- Myocardial infarction, hepatobiliary diseases. Enzymes in inborn errors of metabolism – Phenyl ketonuria, alkaptonuria, throsinosis, albinism, Hartnups disease, Galactosemia, Taysacch's disease, Niemann Pick's diseae, Hunters syndrome, Lesh Nyham syndrome.

Unit IV: Organs Associated with Disease Diagnosis

Liver function test and related disorders:-Jaundice, cirrhosis, hepatitis, fatty liver and gall stones.

Renal function test and related disorder:- Acute renal failiure. Glomerular disease, tubular diseases, urinary tract obstruction, analysis of urinary calculi.

Gastric and pancreatic function test:- Hyper and hypo lipoproteinemias and diagnostic test for lipoprotein disorders.

Unit V: Cancer Biology

Oncology:- Cancer markers for oral cancer. Prostate cancer, Colorectal cance, breast cancer and gastrointestinal tract cancer. Alpha fetoproteins, carcino embryonic antigens, leukemia. Radioisotopes & their clinical applications.

Free radicals in diseases:- Introduction , Types of free radicals. Free radical induced lipid peroxidation and antioxidant enzymes – SOD, Catalase, GPX and GSHs.

Text Books:

1. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company, 1994

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2. Practical clinical biochemistry, volume I and II, 5th edition – Varley *et.al.,* CBS Publishers, 1980.

References

1. Clinical chemistry in diagnosis and treatment 6th edition – Mayne, ELBS Publications, 1994
2. Teitz text book of clinical biochemistry 3rd edition – Burtis *et al.,* William Heinmann medical books, Ltd., 1999
3. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd.1995
4. Clinical chemistry 5th edition – Mosby, Marshall, 2004
5. Clinical chemistry – principles, procedures and correlations, Bishop, Lipppincott, 2000

10MB310 ADVANCED ENDOCRINOLOGY

Credits: 4:0:0

Objective:

The aim of the course is to provide knowledge on the endocrine system, its specific secretions and also the disorder and pathophysiology.

Outcome:

At the end of the semester the students would have learnt about the endocrine regulation, associated diseases and the diagnostic evaluation.

Unit I: Basics Of Endocrinology

Hormones- Introduction, chemical structure. Hormones and homeostasis. Neuroendocrine integration in homeostasis. Classes of chemical messeCngers. Hormone secretion. Transport and clearance. Hormones and behavior. Feed back control of secretion .Mechanisim of hormone action –receptors .second messengers. Cytosolic hormone receptors: Eicosonoids and hormone action. calmodulin. Hormone bioassay-RIA, ELISA.

Unit Ii: Hormones and Growth Factors

Pituitary hormones- Anatomy of pituitary gland, hormones of the pituitary, pathophysiology. Endocrine hypothalamus- structure, hypophysiotropic hormones, control of hypothalamic hormone secretion. Feed back mechanisms. mechanism of action. Neurohypophysis: Synthesis and chemistry of N.H. hormone, control of neurohypophyseal hormone secretion. Roles and mechanism of action of oxytocin, vasopressin. Pathophysiology. Growth hormones: somatotropins and somatomedins, pathophysiology. Growth factors: neurotropic growth factors, hematopoietic growth factors, epidermal growth factor.

Unit Iii : Glands and Hormone Synthesis

Thyroid gland:- Synthesis and chemistry of hormones, control of thyroid hormone secretion, circulation and metabolism, physiological roles, mechanism of action. Pathophysiology. Parathyroid gland: synthesis, chemistry and metabolism of parathyroid gland hormones ,control of secretion. Physiological role and vitamin D. Mechanism of action of calcium

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homeostasis, pathophysiology. Melanotropic hormones- chemistry, role of MSH and mechanism of action. Pathophysiology.Pineal gland - melatonin hypothesis, melatonin secretion and circulation, proposed role of pineal, mechanism of action.

Unit Iv: Endocrine Secretions and Neurohormones

Pancreas:- Endocrine pancreas, insulin, glucagons, somatostatin. Pancreatic peptide – chemistry, physiological roles and mechanim of action. Catecholamines - synthesis, chemistry and metabolism. Neurohormones:- endorphins-source, chemistry, control of secretion; physiological roles. Mechanism of action and pathophysiology.

Unit V: Reproductive Endocrinology

Male reproductive system:- source, synthesis, chemistry and metabolism of androgens, Physiological roles and mechanism of action. Pathophysiology. Female reproductive system:- Ovarian steroid hormone synthesis, physiological role. Neuroendocrine control of organ function. pathophysiology. Endocrinology of pregnancy, parturition and lactation, sex differentiation and development, puberty and hormone control. Human infertility – reasons, therapy and treatment.

Text Books:

1. Goodman HM, Basic Medical Endocrinology. Academic Press. 4th Ed. (2008).
2. Robert F. Dons.Endocrine and Metabolic Disorders: Clinical Lab Testing Manual,4thEd.CRCPress.(2009).

References:

1. Smith *et al.*, Principles of biochemistry. 7th edition –McGraw Hill (2003)
2. William's Textbook of endocrinology 8th edition – Wilson, Foster (2002)

10MB311 MEDICAL BIOTECHNOLOGY

Credits: 3:0:0

Objective: To develop skills of the students in the field of medical biotechnology and its applications in various fields like diagnostics and therapeutics**.**

Outcome: At the end of the course, the students would have learnt about genetic diseases, diagnosis, gene therapy and therapeutic products in medicine. This will serve as a tool to understand the concepts in medical biotechnology.

Unit:I Classification of Genetic Diseases

Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders and Multifactorial conditions. Identification of disease genes. Functional cloning – eg. haemophilia gene . Molecular basis of human diseases - Pathogenic mutations. Gain of

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function mutations: Oncogenes, Huntingtons Disease, Loss of function - Tumour Suppressor Genes, Genomic Imprinting -Mechanisms, Beckwith Weidemann Syndrome.

Unit II : Diagnostics

Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Non-invasive techniques - Ultrasonography, X-ray, maternal serum and fetal cells in maternal blood. Diagnosis using protein and enzyme markers, monoclonal antibodies.DNA/RNA based diagnosis Hepatitis, HIV - CD 4 receptor. Microarray technology- genomic and c DNA arrays, application to diseases

Unit III : Therapeutics - I

Clinical management and Metabolic manipulation – PKU, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism. Gene therapy - Ex-vivo, Invivo, Insitu gene therapy, CFTR Pro drug therapy/ Antisense therapy, Ribozymes. Vectors used in gene therapy Biological vectors – retrovirus, Synthetic vectors– liposomes, receptor mediated gene transfer. Gene therapy trials – Cystic Fibrosis. Encapsulation technology and therapeutics- Diabetes, Hypothyroidism, Bioartificial organs, Artificial Cells- For Haemophilia, Phenyl Ketonuria, Diabetes Stem cell therapy - Embryonic and adult Stem Cells. Potential use of stem cells – Cell based therapies– Nanoparticles, Nanodevices, nanorobotics, Nanomedicine and Nanosurgery – for cancers, neurological disorders.

Unit IV: Therapeutics - II

Conventional medical biotechnology; contemporary issues in medical biotechnology;; human genome, detection of gene mutations; tissue engineering and transplantation; drug delivery;; production of therapeutical monoclonal antibodies and their uses; role of organ transplantation in curing and new organ production; use of transgenic animals in therapy; the principles and practices of transfusion techniques; preparation of blood components and their use; essentials of osteopathic principles; human and veterinary osteopathy and bone grafting.

Unit V: Gene Products in Medicine

Functional cloning – anti-haemophilic factor . Positional cloning- Dystrophin. Gene products in medicine – Humulin,Erythropoietin, Growth Hormone/Somatostatin, tPA, Interferon. DNA based vaccines, subunit vaccines – Herpes Simplex Virus, Attenuated Vaccines– Cholera,Vector vaccines – Cholera and Salmonella

Text Book

1. Medical Biotechnology, P.C.Trivedi, Pointer Publishers, 2008,ISBN

Reference Books

1. Medical biotechnology: achievements, prospects and perceptions, Albert Sasson, United Nations University Press, 2005
2. Medical Biotechnology, Judit Pongracz, Mary Keen Editors Judit Pongracz, Mary Keen Edition illustrated, Elsevier Health Sciences, 2009
3. Microbial biotechnology: principles and applications, Yuan Kun Lee Editor Yuan Kun LeeEdition2, illustrated, World Scientific, 2006

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10MB312 GENETIC ENGINEERING AND MEDICAL ETHICS

Credits: 3:0:0

Objective
Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation, r-DNA technology. To impart knowledge on moral issues, IPR and biosafety.

Outcome
At the end of the semester the students would have learnt about r-DNA technology, genomic library, PCR and other applications of genetic engineering also

- Engineering Ethics and Human Values.
- Moral and Social Values and Loyalty
- The rights of others

Unit I : Basics of Recombinant DNA Technology
Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

Unit II : DNA Manipulation Techniques
Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing- Sanger's method, (Kunkel's Method). Diagnostic importance. Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera

Unit III Applications of rDNA and Bioethics
Cloning in plants, transgenic and knockout animals. Recombinant cytokines and antibodies, vaccines, gene-therapy, stem cell therapy. Invitro fertilization, embryo transfer technology.
What is bioethics? The legal and socioeconomic impacts of biotechnology-Public education of the process of biotechnology involved in generating new forms of life for informed decision-making - ethical concerns of biotechnology research and innovation

Unit – IV IPR and PATENTS
Intellectual property rights -TRIP- GATT- International conventions patents and methods of application of patents-Legal implications-Biodiversity and farmer rights. PATENTS: Objectives of the patent system - Basic principles and general requirements of patent law-biotechnological inventions and patent law-Legal development-Patentable subjects and protection in biotechnology-The patenting living organisms.

Unit – V Biosafety
Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific

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Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

Text Book

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, Sixth edition, 2006.
2. Sasson A, "Biotechnologies and Development ", UNESCO Publications, 1988.
3. Sasson A,"Biotechnologies in developing countries present and future", UNESCO Publishers, 1993.

Reference books

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987
3. Sambrook et al Vol. 1-3, "Molecular Cloning", 2001.
4. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi,2002.
5. "Gene Cloning, An introduction", IV edition, Black well publications, 2001.

10MB313 CLINICAL BIOCHEMISTRY AND EXPERIMENTAL HEMATOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time

10MB314 ENDOCRINOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time

10MB315 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credits: 4:0:0

Objective: To enable the students to acquire knowledge in the field of infectious diseases and interaction with the host's immune system, also various mechanisms by which our immune system protects our body from microbial pathogens.

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Outcome: Students can understand how much the immune system important to the humans. Also can learn the modern techniques in immunology

Unit I: Cells Of Immune System

Experimental Animal Models: inbred strains, SCID mice, nude, knockout mice. hemolytic plaque assay. Cells of the immune system: haematopoiesis. haematopoietic growth factors. Regulation of haematorpoiesis, clinical uses of stem cells. Lymphoid cells – Lymphoblasts CD antigens, T cell membrane molecules. T-cell receptors. Null cells, granulocytes adhesion molecules.

Unit II : Antibody Diversity and Therapeutics

Antigens : B cell epitopes, T cell epitopes, Haptens : viral and bacterial antigens. factor influencing immunogencity, adjuant technology; Immunogloblins: domains classes and biological active antigenic determinants on lmmunoglobins. Immunoglobulins superfamily, Monoclonal Antibodies, gene rearrangements in immunoglobulins. Antigen - antibody interactions invivo - cross reactivity Antigen - antibody interaction invivo -- precipitants, agglutinants, RIA, ELISA - techniques and applications. Immunoglobulin genes - Multigene family, antibody diversity, expression of immunoglobin genes. MHC: Organization, MHC molecules and genes, Cellular distribution, regulation of MHC and immune responsiveness. MHC and disease. Antigen processing and presentation.

Unit III : Complement

Complement Activation: Pathways regulation of complement system, Biological consequence of complement activation, complement deficiencies. Cytokines: IL. IFN, TNF, CSF, Cytokine, receptors, Cytokine antagonists, Cytokines related diseases. B&T cell maturation, activation, proliferation & differentiation

Unit IV: Hypersensitivity Reactions

Hypersensitivity reactions - Type I, II, III & IV. Hypersensitivity disease. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity. delayed type hypersensitivity. Immunological tolerance. Vaccines: Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, Synthetic peptide vaccines, multivalant sub-units vaccines. Immunodeficiency diseases.

Unit V: Autoimmunity

Autoimmunity: Autoimmune disease in human, animal models, mechanism for induction of autoimmunity, Therapy. Transplantation immunology: clinical manifestation, therapy and bone-marrow transplants. organ-transplants. Cancer immunology: Tumor antigens, immune response to tumors, tumor evasion, Cancer immuno therapy. AIDS: Structure of HIV, destruction of T cells, immunological symptoms of AIDS. AIDS vaccine, gene therapy for treatment.

Text books:

1. Kuby immunology 4th edition – Goldsby *et al.,* Freeman and Co. 2000
2. Immunology V-The immune system in health and disease. Janeway Jr.Paul Travels

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and Co., 2001

Reference:

1. Immunology 3rd edition – Roitt *et al.,* Mosby publishers 2009.
2. Cellular and molecular immunology 2nd edition Abbas *et al.,* W.S.saunders, 2008
3. Immunology 3rd edition Tizard, 2007
4. Introduction to Medical immunology 4th edition, Virella, Marcel Dekker Ltd., 2002

10MB316 CLINICAL PATHOLOGY

Credits: 4:0:0

Objective:

The aim of the course is to provide basic knowledge on clinical pathology.

Outcome:

At the end of the semester the student would have learnt about the basics of systemic, immuno, clinical and chemical pathology.

Unit I : General Pathology

Development of Pathology – Important milestones; The structure of the cell; Mechanisms and general effects of cell injury; Necrosis, Apoptosis and Gangrene; Tissue and cellular adaptations, intracellular accumulations, pigments, aging and degeneration; Inflammation and Repair, current topics; Molecular events in cell growth and differentiation.

Unit II: Systemic pathology

Cardiovascular system : Disorders of development, infections, inflammation, degeneration, neoplasia and their effects causing morbidity and mortality; Lung and Pleura : Effects of other systemic disorders, inflammation, obstructive and restrictive disorders, environmental and immunological factors, neoplasia; Diseases of the ear and eye; Gastrointestinal system; Disorders of Kidney and Urinary tract: Congenital disorders, inflammation, immunological influences. Hepato-biliary system; Male and female genital system. Breast : Inflammation, pathogenesis of tumours and tumour like lesions and their diagnosis;

Unit III : Clinical and chemical pathology

RBC disorders – Anaemias, Classification and laboratory investigation; WBC disorders: Leukopenia, agranulocytosis, Leukocytosis, Leukemias and Multiple myeloma; Coagulation disorders; Blood group, Blood banking system and transfusion reactions; cell injury and cellular adaptations; Examination of urine, body fluids and stool; Haemoglobin estimation, Preparation of smears and special staining methods.

Unit IV: Immunopathology

Immune responses, Atopic and Anaphylactic reactions, Cytotoxic reaction, immune complex reactions, delayed hypersensitivity granulomatous reactions. Autoimmunity and Autoimmune diseases. Primary Immunodeficiencies, Acquired Immunodeficiency Syndrome & Amyloidosis.

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Unit V: Histopathology

Receiving of specimens; Grossing Techniques; Fixatives - Mode of action, Indications, Preparations; Decalcification of calcified tissue before sectioning; Processing of tissues for routine paraffin sections and other methods of embedding; Staining principles, preparation of reagents and techniques; Screening techniques.

Text Books

1. Laposata. Robbin's Clinical Pathology. Elsevier Science Health Science Div. 2009
2. James Carton, Richard Daly, Pramila Ramani. Clinical Pathology. Oxford University Press. 2008.

References:

1. James Ewing. Clinical Pathology of the Blood. General Books Publishers. 2009.
2. P. Hamilton, David M Allen, Quantitative Clinical Pathology. Blackwell Publishers. 2000.

10MB317 IMMUNOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time

10MB318 MEDICAL LAB TECHNOLOGY LAB

Credits: 0:0:2

12 Experiments will be notified by the HOD from Time to Time

10MB319 NEUROSCIENCE

Credits: 3:0:0

Objective:

Neurological services and resources are disproportionately scarce due to lack of knowledge and awareness. Neurological disorders are a significant and increasing public health problem. Health promotion and disease prevention are closely related. Focusing on risks to health is a key to preventing any disease onset.

Outcome:

The students are expected to know a basic knowledge of neurology and the disorders of public interest related to it**.**

Unit I: Introduction to Nervous System

Central nervous system – components; Peripheral nervous system – Autonomous nervous system – Sympathetic and parasympathetic. Morphology of the brain and spinal cord.

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Structure and function of the nervous tissue. Types of neurons, CSF. Synaptic cleft and neuromuscular junction.

Unit II: Neurotransmission

Transmission of nerve impulse – resting and action potentials – Polarization, depolarization and repolarisation . Sodium/ potassium pump – Role of calcium. Chemical transmission – neurotransmitters – types, synthesis and secretion of neurotransmitters.

Unit III : Neurotransmitters

Receptors – adrenergic α and β receptors and cholinergic receptors. Regulation of transmission. Enzymatic inactivation of neurotransmitters. Ach. Esterase – inhibitors – neuro toxins. Forces involved in ligand – receptor interaction.

Unit IV : Neuromuscular Coordination

Neuromuscular transmission, reflex action and reflex arc. Regulation of body temperature. Interaction between sense organs and neurons.

Unit V : Neurological Disorders

Dementia –Alzheimer's disease; Epilepsy; head ache; Multiple Sclerosis; Neuroinfection; Neurological disorders associated with malnutrition; Pain associated with neurological disorders; Parkinson's disease; Stroke; Traumatic brain injuries.

Text Books

1. Guyton, A.C. and Hall, J.E. (2005): Textbook of Medical Physiology (W.B. Saunders Co)
2. Geoffrey.I., Zubay, (2007): Biochemistry – 4th Edition

Reference

1. Gerald Karp, (2008): Cell and molecular Biology. (John Welly and Sons)
2. Frederic Martini, (2008): Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)

10MB320 MEDICAL LAB TECHNOLOGY

Credits: 3:0:0

Objective

Medical Laboratory Technology is an allied health profession which is concerned with the diagnosis and prevention of disease through the use of clinical laboratory tests.

Outcome

The students are expected to be thorough in five major areas of the laboratory i.e. in Blood Banking, Clinical Chemistry, Hematology, Immunology and Microbiology.

Unit 1 : Medical Lab management

Laboratory management and planning, Knowledge of maintenance and use of the following : Microscope, Automatic tissue processor, vacuum embedding bath, mictotomes (various

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types with working of each), hot plates, refrigerators, cryostat. Blood Bank refrigerators, Walking coolers, refrigerated centrifuge, incubators, ovens, autoclaves

Unit II: Histopathology

Tissue processing —details of paraffin embedding, vacuum embedding. Decalcification.Section cutting and different types of microtomes. Frozen section — uses and techniques. Staining procedures in Histopathology and haematology.

Unit III: Haemotology

Blood —Collection of haematological specimens, Different methods of estimation of hemoglobin. Salient features and investigations for iron deficiency anemia megaloblastic anaemia and haemolytic anaemia. Peripheral blood smears. Leukaemias, Haemostasis, Haemorrhagic disorders.

Unit IV: Body fluids & excretory products

Examination of stool. Urine—its formation, normal and abnormal constituents. Examination of sputum. Examination of body fluids—pleural, pericardial, ascitic. cerebrospinal fluid and semen examination.

Unit V: Blood bank management

Blood bank management and planning the receiving and recording of blood samples, indexing, Inheritance and nomenclature of ABO and Rh blood group systems, other blood group systems, Transfusion reactions—recognition and investigations. Criteria used while selecting a blood donor.

Text books

1. Medical Laboratory Technology Vol. I, II & III – K.L. Mukherjee.2008, Tata McGrawHill Publishing company, New Delhi.
2. Medical Laboratory Technology – C.R. Maity, 2005, New Central Book Agency Pvt Ltd. Kolkata.

References

1. Varley's Practical Clinical Biochemistry –Alan H Gowenlock, 6/e, 2009, CBS Publications &Distributors, New Delhi.

10MB321 COMPLEMENTARY AND ALTERNATIVE MEDICINE

Credits: 3:0:0

Objective:

The objective of the present subject is to provide a clinical application of alternative medicine practices including alternative, complementary and homeopathic medicine in managing health.

Outcome:

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The paper will help the candidate to study about the healing paradigms, philosophies, theoretical basis and techniques of various complementary and alternative medicines. This paper also describe the knowledge, attitudes and skills necessary to communicate effectively with practitioners and users of complementary and alternative medicine.

UNIT : I Basics of complementary and alternative medicine

Health : The traditional approach -Approach in various systems of medicines and healing - Emerging new visions from systems and holistic approach. The Western System of (Allopathic) Medicine and its advantages and limitations.

UNIT : II Traditional Indian System of Medicine

Advantages and limitations of Ayurveda System, Unani system, Homeopathy system, Siddha system, Naturopathy and Folk & Traditional system.

UNIT : III Alternative medicines and therapy I

Acupressure, Acupuncture, Massage Techniques, reflexology, reichian body therapy,therapeutic touch , shiatsu, electro therapy, dance Movement therapy, Physical and psychic exercises , relaxation technique.

UNIT : IV Alternative medicines and therapy II

Hydro therapy, mud therapy, Music therapy, Art therapy, sound therapy, Pyramid power, floatation therapy, gem essence therapy, Colour therapy, Polarity therapy, cymatics, geopathic therapy, Magneto therapy. Diet – health food –Herbal therapy -flower therapy – Megavitamin therapy –Fasting as therapy.

UNIT : V Exercise and therapy

Alcoholism , addictions and deaddication techniques -Responsible Parenthood -do's and Don't do's for a health life – Prayer and spiritual dimensions of Healing –Place of Yoga and meditation. Counseling, Psychotherapy, Primal therapy, behavioral Therapy, Charismatic healing Bioenergetics, Hypnotherapy, Faith healing.

Textbooks

1. Wayne B. Jonas, MD; Jeffrey S. Levin, PhD, MPH. Essentials of Complementary and Alternative Medicine. 1999.
2. Stephen Barrett. Complementary and Alternative medicine in the United States. National Academic Press. 2005.

References

1. M.K. Gandhi: Nature cure, 2003
2. Herron R, Fagan J. Lipophil-mediated reduction of toxicants in humans: an evaluation of an Ayurvedic detoxification procedure. Alternative Therapies in Health & Medicine, Sep/Oct 2002; 8(5):40-52.
3. Chopra A, Doiphode V. Ayurvedic medicine. Core concept, therapeutic principles, and current relevance. *Med Clin North Am*. 2002 Jan;86(1):75-89.

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10MB322 MOLECULAR MEDICINE

Credit:3:0:0

Objective

To Recognize the relationship between technological advances and the effects arising as technologies become widely used. To Understand molecular medicine from a historical perspective as a simple extension of the mandate of science to improve the lot of humans and other life on earth.

Outcome

To learn the possible ways in which modern biochemistry and biotechnology could help in molecular diagnosis and treatment;

Unit I : **Historical Perspectives – Technology & Society**

The Molecular World: DNA, RNA, Proteins and Cells; The structure and expression of prokaryotic and eukaryotic genes. Overview of the basic techniques used to study DNA, RNA, and proteins. Pathophysiology & Mechanisms of Human Disease

Unit II: From Gene to Protein to Disease

Moleculaar diagnosis; Cellular and Molecular Biology of Disease. Transgenic animals as models for human disease, molecular approaches to cancer, cardiovascular disease, inborn errors of metabolism, genetics of human psychiatric disorders, autoimmune disease, and immune deficiency disease.

Unit III: Oncogenes

The basic biology of cancer; Genetic basis of cancer; human, animal, and virus studies Cytogenetics and cancer; G-banding, SKY, and FISH; Inherited predisposition to cancer Mutation and cancer; types of mutations and maintenance of genome integrity. Experimental identification of oncogenes and tumor suppressor genes; chromosomal rearrangements, CGH, LOH, positional cloning, RDA, and genomics-based methods

Unit IV: Genetic Disease – Genomic Considerations:

General principles of inheritance, mutation,variation,and Mendelian genetics. Some commonly used techniques: the 2-hybrid system, RNAi, Microarrays, High-throughput sequencing.Genetically engineered stem cells and experimental therapies. Stem cell based therapies: stem cells and repair of heart and nervous system; regeneration strategies. Skin replacement, brain cell transplantation and stem cells in aging

Unit V: Personalized Medicine and the Right to Privacy(11)

Method & Logic of Translational Biology; Introductory Biostatistics for Translational Research; Proteomics and Functional Genomics, Ethics, Conduct & Practical Aspects of Clinical Research.

Text Books:

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1. Murphy, Traver & Walport, 2008. Janeway's Immunobiology the immune system in health and disease. Seventh edition. Garland Science Publisher

Reference:

1. Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter. 2002 Molecular Biology of the Cell**.** Garland Science.
2. Jean Brachet and Alfred E Mirsky. 2003 The Cell Biochemistry, Physiology and Morphology, Academic Press, New York.
3. Harvey Lodish *et al*., 2000, Molecular Cell Biology – 4th ed. W H Freeman, NY.

10MB323 CELL CULTURE TECHNIQUES

Credits: 3:0:0

Objective:
The aim of the course is to provide basic knowledge on cell and tissue culture.

Outcome:
At the end of the semester the student would have learnt about the basics and various methods of cell cultures.

Unit I: Basics of Cell culture
Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures, suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

Unit II: Human diseases and their diagnosis
Bacterial and viral diseases in Humans; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, *in-situ* hybridization; northern and southern blotting; RFLP.

Unit III: Therapy of Human Diseases
Recombinant cytokines and their use in the treatment of infections; monoclonal antibodies in therapy; vaccines and their applications in infections; gene therapy for diseases.

Unit IV: Micromanipulation of Embryos
Micromanipulation technology - equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples; artificial insemination and germcell manipulations; in vitro fertilization and embryo transfer.

Unit V : Transgenic Animals
Concepts of transgenic animal technology; strategies for the production of transgenic animals

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and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

Text books

1. Arora M.P.(2003), Biotechnology,Himalaya Publishing House, Mumbai.
2. Freshney R. Ian (2006), Culture of Animal Cells:A Manual of Basic Techniques, John Wiley and Sons, Inc., New York.

References

1. Gangal Sudha (2007), Principles and Practice of Animal Tissue Culture, Universities Press India Pvt.Ltd.
2. Gupta P.K (2004), Biotechnology and Genomics, Rastogi Pub.Meerut.
3. Ignacimuthu S.(1995), Basic Biotechnology,Tata McGraw Hill Publishing Co. Ltd.,New Delhi.
4. Purohit S.S. (2002),Agricultural Biotechnology,Agrobios India, Jodhpur.
5. Satyanarayana U. (2007), Biotechnology, Books and Allied Pvt.Ltd. Kolkata

10MB324 PHARMACOLOGY AND PHARMACOGNOSY

Credit 3:0:0

Objective

Helps the student to understand and apply this knowledge in research to pharmacology and basics of pharmacognosy.

Outcome

At the end of the semester the students would have learnt about basics of drug action in various system and natural sources as medicine.

Unit I : Basics of Pharmacology

General concepts of Pharmacology, ADME process, drug action- mechanism, factors affecting drug action. Dose-effect relationship

Unit II : Systemic Pharmacology

Drugs Affecting the Central Nervous System, Cardiovascular and Renal Systems, Immune system, Respiratory System, Gastrointestinal System and Nutrition, Endocrine System, Integumentary system and Eyes/Ears. Drugs affecting uterine motility, Chemotherapy of parasite infections, Chemotherapy of microbial diseases. Antineoplastic agents, Immunomodulators. Drugs acting on blood and blood forming organs

Unit III : Experimental Pharmacology

Experimental methodologies involved in the discovery of drugs (*in vivo, in vitro, ex vivo*). Animal handling and animal care. Methods of anaesthetising animals and methods of euthanasia. Restraining and blood collecting methods.

Unit IV: Pharmacognosy

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General aspects of sources of natural medicinal products**.** Marine Pharmacognosy and its applications. General cultivation of medicinal plants, their merits and Demerit -a. General aspects, b. Factors involved, c. Methods used to improve the Quality and d. Pest control. Role of natural pesticides – Preparation and uses.

Unit V: Isolation and Characterization of Phytochemicals

General methods and Principles of extraction methods, types of extraction and their merits and demerits. Selection and purification of solvents for extraction, methods of isolation, purification and identification of phytoconstituents.

Text Books:

1. Lippincott's illustrated reviews: Pharmacology **by** Richard a Harvey, Pamela C Champe B000APHLSY Pamela C Champe (Editor)

   › Visit Amazon's Pamela C Champe Page
   Find all the books, read about the author, and more.
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   , Richard Finkel, Luigi X Cubeddu , B001IGSJLC Luigi X Cubeddu (Editor)
   › Visit Amazon's Luigi X Cubeddu Page
   Find all the books, read about the author, and more.
   See search results for this author
   Are you an author? Learn about Author Central
   michelle a clarke, 4th edition, 2008
2. Basic & clinical pharmacology By Bertram G. Katzung, 2006.

Reference

1. Pharmacognosy by G.E. Trease, W.C. Evans, ELBS, 2002.
2. Pharmacognosy by Varro E.Tyler, Lynn. R.Brady, James E.Robbers, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis, CBS Pub. Delhi,1985.

10MB325 MOLECULAR BIOTECHNOLOGY

Credits: 4:0:0

Course Objective:

A wide aspect of recombinant DNA technology, Gene expression – Analysis and vaccine production.

Course Outcome:

The candidates can have an industrially applied knowledge on genetic engineering, vaccine production with respect to quality analysis and quality control.

Unit I: Basic Molecular Biology

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DNA replication - Transcription, post-transcriptional modifications, Regulation of transcription - Translation and post translation modification, inhibition of protein synthesis – Regulation of Gene expression-lac operon.

Unit II: Recombinant DNA technology
Introduction to rDNA technology,restriction endonucleases,vectors,cloning,eukaryotic expression vectors,yeast vectors,*insitu* vectors,mammalian and plant vectors.

Unit III: Directed mutagenesis and protein Engineering
Random and site directed mutagenesis(Kunkels method),protein engineering by DNA shuffling to increase enzyme activity and protein stability.

Unit IV: Immunological diagnostic tools.
Molecular and serological diagnostic tools-Monoclonal antibodies,PCR and realtime PCR,FISH.

Unit V: Applications of recombinant DNA technology.
Transgenic animal (mice),Knock out animal, Recombinant antibodies and vaccines, Gene therapy, stem cell therapy.

Text books:

1. Genetics – a molecular approach, T.A. Brown, 2000
2. A test book on Biotechnology, Ed. 2, Kumar H.D, Affiliated East West Press Private Ltd. New Delhi, Ed. 2, 1998

References

1. Molecular Biology and Biotechnology, Walker and Raplery, Panima, Ed. 3 2003
2. O.R.W. Primrose, Principles of gene manipulation, an introduction to genetic engineering, Blackwell Scientific publications, 2001

10MB326 MOLECULAR PHYSIOLOGY

Credit: 4:0:0

Course Objective:
Basic physiology of the human system is brought into limelight and their functioning is studied for application of nanotechnology.

Course Outcome:
This paper will be a bench marking for students proposing to do their higher studies in nanotechnology and biomedical implants design based on their physiological functions.

Unit I: Endocrine System
General concept on Exocrine secretions. Liver and Pancreatic secretions. General concept on Endocrine Secretions – Structure and function of kidney – Basics of Animal Tissue culture.

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Unit II: Muscular System
Excitation and contraction of muscles – molecular organization of muscle, protein of contractile element; their organization and role in contraction; Energy for contraction. Cardiac physiology – circulation, electrophysiology of heart. Measurement of blood pressure, hypo and hypertension.

Unit – III: Circulatory System
Blood gas analysis. Acid – base balance and status. Buffer systems of body fluids and their role. Respiratory mechanisms in acid-base balance. Respiratory response to acid-base balance. and abnormal electrolyte composition of blood – metabolic acidosis and alkalosis.

Unit – IV: Nervous System
Brain: chemical composition, metabolism and metabolic adaptation, neurotransmitter and cAMP. Biochemical aspects of learning and memory. Enkephalins and endorphins. States of brain waves, epilepsy and psychoses.blood brain barrier, Nervous system: General organization – function units; resting and action potential; conduction of nerve impulse, synaptic transmission, compounds affecting synaptic transmission, neuromuscular junction.

Unit – V: Metabolic System
Mineral metabolism: organization of Bone-Matrix; Cells of bone and their biochemical characterization. Markers of bone metabolism. Synthesis of collagen and their matrix components – elastin and other fibres. Integrated control of mineral metabolism. Interrelationship of calcium, vitamin D, Calcitonin and PTH.

Textbooks:

1. West, E.S and Todd, W.R (1985) : Text book of Biochemistry (McMillan)
2. Guyton (1999); Medical Physiology (WB Saunder's Company)

References

1. Zubay (1998): Biochemistry – 4th Edition (WMC Brown Publishers)
2. Talwar, G.P., Srivastava, L.M. and Momdgill, K.D.: Text book of Biochemistry and Human Physiology.

10MB327 BIOMATERIALS

Credit: 4:0:0

Course Objective:
To give a broader perspective on biomaterials and their functions with human systems.

Course Outcome: The students will have a clear picture on the synthesis of biomateirals and their application in human physiological systems.

Unit I: Implant materials
Steps in the fabrication of implants - Microstructures and properties of implant metals - Hydrogen – properties and application - Types of implants - Currently available degradable

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polymers - Types of bio-ceramics: Tissue attachment - Native Collagen and Elastin - Chemical modifications of collagen

Unit II: Biomaterial implants and biomaterial degradation.

Association of implants with human and animal tumors - Pathobiology of foreign body tumorigenesis - Implant associated infection - *In vitro* and *in vivo* assessment of tissue compatibility - Chemical and biochemical degradation of polymers - Oxidative biodegradation - Pathologic calciferation of biomaterial - Assessing calciferation of biomaterial - Prevention of calciferation.Mechanism of bioerotion and chemical degradation.

Unit III: Application of biomaterials in medicine

Cardiovascular applications: Cardiopulmonary Bypass, Hear valves - Vascular grafts, Pacemakers, Vena-cava filters and Total artificial heart - Blood substitutes, future directions - Dental implant systems - Contact lenses: Principles, soft and rigid contact lenses - Implants of Cornea and Glaucoma - Water penetration controlled systems - Chemically controlled devices for drug delivery systems- Biocathetars.

Unit IV: Principles of drug Delivery systems:

Modes of Drug Delivery- ADME Hypothesis - Controlled drug delivery, Delivery of Drugs, antibody based and metabolism based targeting – Nanoparticles surface modifications, bioconjucation, pegylation, multi-fuctional gold nanoparticles for drug delivery- Virus based nanoparticles

Unit V: Drug Carriers Nanoparticle and targeted systems for cancer diagnosis and therapy

Synthesis- nanoscale containers- Nanoscaffold systems –Biocompatibility- Liposomes for pharmaceutical and cometics applications Liposomal drug carriers in cancer therapy– Lipid based drug delivery systems for peptide and protein drug delivery- Liposomal anticancer and antifungal agents- Targeted delivery through enhanced permeability and retention – folate receptors- targeting through angiogenesis- targeting to specific organs or tumour types – tumour specific targeting – breast cancer- liver cancer- targeting tumor vasculature for imaging delivery of specific anticancer agents such as Paclitaxel, doxorubin, 5- fluorouracil.

Text books:

1. Biomaterials, SV Bhat, Ed. 2, Narosa publishers, 2009
2. Biomaterials Science and engineering, JB Park, Plenum press, New York,Ed.6, 2002

References

1. Micromachines as tools for nanotechnology, H. Fujita, Springer, 2003
2. Biological nanostructures and applications of nanostructures in biology, Michael Stroscio, Mitra Dutta, Kluwer academic publishers, 2004
3. Nanocomposites, A.D. Pomogailo, V.N. Kestelman, Springer, 2005
4. A.R.Leach, “Molecular Modelling Principles and Application”, Longman, 1996.
5. J.M.Haile, “Molecular Dynamics Simulation Elementary Methods”, John Wiley and Sons, 1997.

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6. Satya Prakash Gupta, "QSAR and Molecular Modeling", Springer - Anamaya Publishers, 2008.

10MB328 BIOLOGICAL AND BIOMEDICAL NANOTECHNOLOGY

Credit: 4:0:0

Course Objective
The principles and synthesis of nano scaffold preparations are offered in this paper.

Course Outcome
A detailed account of Drug development and binding mechanisms would be appreciated and furthur research cab.

Unit I: Microspheres for drug delivery
Introduction, Background - Fabrication of polymer micro and nanoparticles, Fabricating uniform microspheres - Percision particle fabrication technology - Fabricating uniform core-shell microparticles - Electrodynamic spraying - Controlled *in vitro* release from precision microspheres and mixtures of uniform microspheres - *In vitro* release with double-wall microspheres - Release from monodispense microspheres - Current status of using microspheres: a few case study

Unit II: Inorganic binding polypeptides in bio-nanotechnology
Selection of inorganic-binding polypeptide - Binding affinity: Molecular adsorption of GEPI - Physical specificity and molecular modeling - Potential applications of molecular biomaterials - Bio-nanofabrication: Silica synthesis using inorganic binding polypeptide - Future prospects and applications in nanotechnology - Polymer design for non-viral gene delivery - Synthetic and Natural polymer genes carriers: examples - Biomaterials approach to gene delivery

Unit III: Dynamic nanodevices based on protein molecular motors
Protein molecular motors: Biophysical aspects - Nanodevices based on protein molecular motors, Motility assays and single molecule techniques - Interaction of motor protein with the device environment - Design, fabrication of protein molecular motor based nanodevices – Lateral confinement of movement - protein molecular motors.

Unit IV: Nanoscale polymer fabrication for biomedical applications
Biomedical applications of polymer nanostructures - Mold making and prototyping - Assembly and bonding - Future directions in polymer fabrication - 3D microfabrication – definition, 3D-microparts for trans dermal drug delivery system - Emerging methods for 3D micro and nanofabrication, two photon assisted micro-fabrication – Nano imprint and soft lithography - Nanogaps for molecular conductivity measurements

Unit V: Nanodevices in biomedical applications

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Integrating biomolecules into devices - Low throughput construction methods and "one-off" nanostructure - Biomolecules in therapeutic nanodevices, self assembly and orthogonal conjugation - Delimiting nano-therapeutic action in three dimensional space - Spatially and temporally delimiting nano-therapeutic action - Sensing approaches - Imaging using nano-therapeutic contrast agents - Hybrid nanotherapeutic devices in oncology – Nano-therapeutics for cardiovascular applications - Hybrid nano-therapeutics and specific host immune responses.

Text books:

1. Biological nanostructures and applications of nanostructures in biology, Michael Stroscio, Mitra Dutta, Kluwer academic publishers, 2004
2. Nanomaterials for nanoscience and nanotechnology, Zhong Lin Wang, Wiley-VCH, 2000

References:

1. Biomolecules meet nanotechnology, Review article, Angew. Chem. Int. Ed., 2001, 40, 4128 -4158
2. Nanobiotechnology, C.M. Niemeyer, C.A. Mirkin, Wiley-VCH, 2004
3. The handbook of nanotechnology, J.C. Miller, R.M. Serrato, J.M.R. Cardenas, G.A. Kundahl, John Wiley & sons, 2004

10MB329 BIOTECHNOLOGY LAB - II

Credit: 0:0: 2

12 Experiments will be notified by the HOD from Time to Time

10MB330 BIOTECHNOLOGY LAB - III

Credit: 0:0: 2

12 Experiments will be notified by the HOD from Time to Time

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ADDITIONAL SUBJECTS

Sub. Code	Name of the Subject	Credits
11BT201	Biostatistics	4:0:0
11BT301	Process Equipment Design and Drawing	4:0:0
11BT302	Enzyme Technology and Industrial Applications	3:0:0
11BT303	Advanced Environmental Biotechnology	3:0:0
11BT304	Advanced Animal Biotechnology	3:0:0

11BT201 BIOSTATISTICS

Credits: 4:0:0

Course Objective

To provide knowledge and skills sufficient to allow students to understand the role of statistics in biology research. To develop skill in the basic methods of data gathering and analysis.

Course Outcome

To provide sufficient background to be able to interpret statistical results in research papers. To develop sufficient knowledge of probability and probability distributions to support further studies in biostatistics and research.

UNIT I

Organization of Statistical investigation- object and scope, Classification and tabulation of data- Individual, discrete and continuous series, Diagrammatic and graphical presentation of data using line, simple and multiple bar diagram, Pie diagram. Histogram and frequency polygon

UNIT II

Methods of sampling- Random and non-random sampling, Sampling distribution and test of significance: Testing of hypothesis and tests of significance, Standard error, Student's 't' test, Chi - square test & goodness of fit- Simple problems.

UNIT III

Measures of central tendency: arithmetic mean, median, mode for individual, discrete and continuous data. Measures of Dispersion: standard deviation and coefficient of variance for individual, discrete and continuous data. Correlation analysis- Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method, simple problems

UNIT IV

Regression analysis: Definitions, Graphical method and algebraic methods, Regression equations- Simple problems. Probability: definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability- Simple problems.

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UNIT V
Analysis of variance, Techniques of analysis of variance: one way and two-way classification of ANOVA.

Text Book:

1. Biostatistics, Ramakrishnan, R. 2010, Saras Publications.

Reference Books:

1. Statistical methods for Biologists, S. Palanichamy and M. Manoharan, 2009, Paramount Publications.
2. Statistical Methods, S. P. Gupta, 2008, S.Chand & Sons.

11BT301 PROCESS EQUIPMENT DESIGN AND DRAWING

Credits 4:0:0

Course Objective
To design safe and dependable processing facilities in a cost effective manner. This course focus on plant layout and design of piping systems.

Course Outcome
At the end of the course the student will be familiar in design and engineering principles involved in process plant layout and piping design.

UNIT I: ENGINEERING PROPERTIES
Selection of materials, Engineering properties of various materials at different temperatures. Factor of safety - Working stresses. Application and use of various codes and standards in design. Piping and Instrumentation Diagrams.

UNIT II: STORAGE TANKS
Design of tall vertical and horizontal vessel storage tanks. Foundations and supports for equipments and tanks. Internal and external pressure vessel calculations.

UNIT III: FERMENTOR DESIGN
Introduction to fermentor, types of fermentor, fermentor accessories and various parameters for design, Design of airlift fermentor.

UNIT IV: SEPARATION EQUIPMENT
Types of centrifuge, Design of top suspended bottom discharge centrifuge; types of filtration, design of plate and frame filter press; design of swenson walker crystallizer.

UNIT V: HEAT & MASS TRANSFER EQUIPMENTS

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Introduction to heat transfer and mass transfer, Design of 1-1shell and tube heat exchanger; design of single and multiple evaporator; design of counter current extraction; types of dryer and design of rotary dryer.

TEXT BOOKS:

1. Indian Standard Codes:
   (a) IS : 2825 - 1969: Code for Unfired Pressure Vessels.
   (b) IS : 4049 - 1979: Specifications for formed ends for Tanks and Pressure vessels.
   (c) IS : 4179 - 1967: Sizes of Process Vessels & their Leading Dimensions.
   (d)IS: 4864 to 4870 - 1968: Specifications for Shell Flanges for Vessels and Equipment.
   (e) IS : 4503 - 1967: Specifications for Shell & Tube Heat Exchangers.
   (f) IS : 803 - 1962: Code of practice for Design, Fabrication and Erection of Mild Steel Cylindrical Welded Oil Storage Tanks. (Published by Bureau of Indian Standards, New Delhi).
2. Joshi, M.V. Process Equipment Design, IIIrd Edn 2004 , MacMillan, India,.

REFERENCE BOOKS:

1. Perry, R.H. & Green, D.W.: Perry's Chemical Engineers' Handbook,7th Edn 2000, McGraw Hill.
2. Coulson, J.M., Richardson, J.F. & Sinnott, R.K. Chemical Engineering, Vol. VI 1999, Maxwell-Macmillan, New York.
3. Brownell, L.E, & Young, E.H. Process Equipment Design 2004, Wiley Eastern, New Delhi

11BT302 ENZYME TECHNOLOGY AND INDUSTRIAL APPLICATIONS

Credit: 3:0:0

Course Objective

To understand the mechanism of Biocatalyst and the kinetics behind its extraction and purification procedures, immobilization techniques etc.

Course Outcome

The students will be able to understand the concept of immobilization extraction and purification and the inhibition kinetics of the enzymatic reactions

UNIT-I CLASSIFICATION AND MECHANISM OF ENZYME ACTION

Classification of enzymes, quantification of enzyme activity and specific activity. Effect of pH and temperature on enzyme activity.

UNIT-II KINETICS OF ENZYME ACTIONS

Estimation of Michaelis Menten parameters, Enzyme Inhibition – Substarte, Product and Toxic compound inhibition, types and derivation.

UNIT-III APPLICATION OF ENZYMES

Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications.

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UNIT-IV MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS

Techniques of enzyme immobilisation Analysis of film and Pore diffusion Effects on kinetics of immobilised enzyme reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors

UNIT-V ENZYME BIOSENSORS

Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

Text Books:

1. T. Palmer, P.L. Bonner, Enzymes: Biochemistry, Biotechnology, Clinical chemistry, 2nd Edn 2007, Harwood Publishing Ltd.

Reference Book

1. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed 2010, McGraw Hill.

11BT303 ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

Credits: 3:0:0

Course Objective

To develop skills of students in various biological phenomena, which can be exploited to save environment from eventual deterioration.

Course Outcome

At the end of the course, the students would have learnt about the environmental related issues and the Problem solving ability

UNIT I ENVIRONMENTAL POLLUTION AND SOCIAL ISSUES

Definition and Scope of Environmental Biotechnology; Control measures of environmental pollution- Kyoto protocol. Social Issues- Green House Gases, Global Warming-Climate change, acid rain and nuclear holocaust.

UNIT II INDUSTRIAL WASTE WATER MANAGEMENT

Purification of waste water; Aerobic and anaerobic treatments; Laboratory methods for the detection of coli form organisms in water; Water recycling methods; Management of radioactive pollutants.

UNIT III BIOMASS, ENERGY AND SOLID WASTE MANAGEMENT

Biomass waste as renewable source of energy; Methods of energy production; Conversion of Solid Waste to Methane; Biogas production; Biofuels and Microbial fuel cells; Management of

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Sludge and Solid waste treatment- Land filling, lagooning, Composting and Vermi Composting,Ecofriendly agriculture.

UNIT IV BIODIVERSITY AND CONSERVATION

Definition, Types, Genetic, Species, Ecosystem; Biodiversity at Global Levels, IPR and Patenting, Patenting of plants, animal and microbial DNA Sequences; Plant Breeders Right and Farmers Right.

UNIT V BIOREMEDIATION AND BIODEGRADATION

Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation Biodegradation of Hydrocarbons, Pesticides, Herbicides, Insecticides and Xenobiotics.

Text Books:

1. R. C. Dubey, Textbook of Biotechnology, 2006, S. Chand & company Ltd
2. Indu shekhar Thakur,. Environmental Biotechnology- Basic concepts and Applications 2006, I. K. International Pvt. Ltd..

Reference Books:

1. Stanier R.Y. Ingraham J.L. Wheels M.L. Painter R.R, 2005. General Microbiology. MacMillan Publications,
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals 2010, 2nd Ed., Mc Graw Hill,
3. Alam Scragg, Environmental Biotechnology 2005, Oxford university press, USA

11BT304 ADVANCED ANIMAL BIOTECHNOLOGY

Credits 3:0:0

Course Objective

To impart knowledge on techniques involved in animal biotechnology.

Course Outcome

At the end of the course the students would have learnt about strategies and methodologies, cloning, xenotransplantation, transgenic animals etc.

UNIT 1: CELL CULTURE CONCEPTS

Aseptic techniques; media and reagents; contamination; Primary and Secondary culture; Characterization, maintanance, preservation. Organ culture, embryo culture, strategies involved in stem cell culture and their therapeutic applications.

UNIT II: LARGE SCALE CELL CULTURE OPERATIONS

Scale up in monolayers; Suspension culture, types; Cell culture reactors; Mixing and aeration; perfusion, fluidized beds, Microencapsulation. Production of Vaccines and pharmaceutically important proteins in animal cells.

UNIT III APPLICATIONS OF ANIMAL BIOTECHNOLOGY

Xenotransplantation, Human Gene therapy (including the principle and strategies followed in si RNA and ribozyme methods) –vectors used, limitations and applications. Expression of recombinant proteins in

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insect (baculovirus) and animal cell – Expression vector, over production and downstream processing of the expressed proteins. Gene knock-outs in mice- applications

UNIT IV: ANIMALS AS BIOREACTORS

Transgenic animals – Production and applications of commercially important proteins; silk worm, fish, cattle, mice (biopharming in animals) –as bioreactors

UNIT V: IPR, BIOSAFTEY AND ETHICAL ISSUES IN ANIMAL BIOTECHNOLOGY

Patents and Patentable Inventions, Biosaftey and levels; Social, moral and ethical considerations in Animal Biotechnology; ELSI (Ethical, legal and social impacts) related with stem cell technology, human gene therapy and xenotransplantation

Text Books:

1. Freshney. Culture of Animal cells, 6th Ed. 2008, Wiley-Liss.
2. Portner R. Animal Cell Biotechnology, 4th Ed, 2007. Humuna Press.

Reference Books:

1. Manjula Shenoy. Animal Biotechnology, 2009, Laxmi Publishers.
2. Spier RE and Griffiths JB, Animal Cell Biotechnology, Vol VI, 2006. Academic Press.

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