I Year I Semester B.Tech. (Biotechnology)

Course No.	Title	Credit
Bio-chem-111	Bio-chemistry-I	3+1
Chem-111	Chemistry	3+1
BT-111	Basics of Microbiology	2+1
BT-112	Cell Biology	3+1
ME-111	Heat & Mass Transfer	2+1
ME-112	Fluid Mechanics and Hydraulics	2+1

Bioch.- 111 **BIOCHEMISTRY-I 4(3+1)Sem.I**

THEORY

UNIT-I

Introduction to Biomolecules: Overview- Basic principles of organic chemistry, types of biomolecules, chemical nature, biological role, biological buffers, water and its importance in biotechnology.

UNIT-II

Structure and Properties of Common Types of Biomolecules: Carbohydrates (Mono, di, oligo and polysaccharides), Lipids (fatty acids, glycerolipids, phospholipids, glycolipids, sphingolipids, steroids) Amino acids, peptides, proteins and conjugated proteins like Glycoproteins and lipoproteins. Purines, pyrimidines, nucleosides, nucleotides, Ribonucleic acids and deoxyribonucleic acids, nucleoprotein complexes.

UNIT-III

Metabolism: Introduction to biocatasis by enzymes and pathways. Biosynthesis and breakdown of carbohydrates, lipids, proteins and nuclei acids.

Intermediary Metabolism: TCA cycle, glycolysis, gluconeogenesis, pentose phosphate shunt, Embden Meyerhof pathway, urea cycle, interconnection of pathways, metabolic regulation.

UNIT-IV

Bioenergetics: High energy compounds, electronegative potential of compounds, respiratory chain, TP cycle, calculation of ATP production during glycolysis and TCA and regulation of levels of high-energy compounds and reducing equipments inside the cell.

PRACTICALS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer – titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates-distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from inino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyberchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by TGO method after hydrolysis of starch with acid and specificity of the enzymatic method.

Suggested Text Books:

i) Lehninger's Principles of Biochemistry by David L. Nelson and Michael M Cox, Macmillan Worth Publisher.

ii) LubertStryer, Biochemistry, 4th edition, WH Freeman & Co., 2000.

iii) Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.

iv) Murray, R.K., Granner, B.K. Mayes, P.A., Rodwell, V.W., Harper's Biochemistry Prentice Hall International.

Chem.- 111 **CHEMISTY (3+1)** **Sem. I**

UNIT-I

Electro Chemistry: Galvanic cells, Reversible and irreversible cells, emf and its electrodes, Single electrode potential, Standard electrodes (H_2& calomel electrodes), electrochemical series, Nernest equation, Problem metal, metal ion electrode, metal, metal insoluble salt electrode, glass electrode, determination of pH using glass electrode, application of emf measurement, problems, concentration cells, application, problems, ion selective electrodes, Kohlrausch law of independence, migration of ions, application, conduct metric titration's, polarization, over voltage, decomposition potential.

UNIT-II

Thermodynamics: Thermodynamic terms; definition of system; open, closed, isolated-surrounding, properties of system, state of a system; Thermodynamic equilibrium, isothermal, isobaric, isochoric and adiabatic processes; internal energy; mathematical form of first law; enthalpy- limitation of first law, statement of second law of thermodynamics; Clausius and Kelvin- definition of entropy, entropy change for a reversible process, entropy change for an isothermal expansion of an ideal gas, problem, entropy of phase transition, problem, definition of free energy and work function; Gibbs Helmholtz equation- application, problem; Van't Hoff isotherm and isochore- application, problems.

UNIT-III

Chemical Kinetics: Kinetics of second order reaction, Characteristics of second order reaction-half life period, examples of second order reaction, Hydrolysis of ester by sodium hydroxide, simple problem in second order kinetics, Kinetics of opposing, parallel and consecutive reaction, examples of consecutive reaction, decomposition of dimethyl ether in gaseous phase, radioactive decay of polonium, examples of parallel reaction, reaction of ethyl bromide with caustic potash, example of opposing reaction, dissociation of hydrogen iodide, effect of temperature on reaction rate, theory of absolute reaction rate- steady, state principle.**Surface Chemistry and Catalysis:** Adsorption- types of adsorption, adsorption of gases on solids, adsorption isotherm; Freundlich, Langmuir isotherms, adsorption of solutes from solution, application, role of adsorption in catalytic reaction, ion exchange adsorption; basic principles in adsorption chromatography; Catalysis- classification, characteristics of catalyst, autocatalysis, enzyme catalysis, Michaelis; Mention equation, acid base catalysis.

UNIT-IV

Spectroscopy: Electromagnetic spectrum, adsorption of radiation, electronic transition, vibrational transition , rotation \al transition, intensities of spectral lines, Beer Lambert's law, Colorimetric analysis, estimation of concentration of a solution by colorimetry, flame photometry- theory, instrument (block diagram only) and application, visible & UV spectroscopy- principles, instruments (block diagram only) and simple application, IR spectroscopy- simple application only.

PRACTICALS:

Weighing and preparation of standard solutions:

i) Preparation of molar and normal solution of the following substances- oxalic acid, sodium carbonate, sodium hydroxide, hydrochloric acid.

ii) Preparation buffer solution: borate buffer, phosphate buffer using Henderson equation.

Water analysis:

i) Determination of total hardness, temporary and permanent hardness of water EDTA method.

ii) Determination of DO content by Winkler's method.

iii) Determination of alkalinity in a water sample.

iv) Determination of chloride content of water sample by argenometric method.

pH measurement: To find out the strength of given hydrochloride acid by sodium hydroxide.

Conductometry:

i) Conductometrictitration of mixture acids.

ii) Conductometric precipitation titration using $BaCl_2$ - Na_2SO_4

Potentiometry: Redox titration- Iron v/s dichromate.

Spectrophotometry: To determine the iron content of an unknown solution (1, 10-phenanthroline / thiocynate method)

Flame photometry: To determine sodium and potassium in water.

Viscometry: Determination of molecular weight of a polymer.

BT- 111 BASICS OF MICROBIOLOGY 3(2+1) Sem. I

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 (yeast & mold) actinomycetes, mycoplasma, viroids and prions.

UNIT-III

Microbial Nutrition, Growth and Metabolism: Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitative bacterial growth.**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.

UNIT-IV

Industrial and Environmental Microbiology: Biogas; leaching of ores by microorganisms; bio-fertilizers and bio-pesticides; microorganisms and pollution control; biosensors.

PRACTICALS:

1. Laboratory safety and sterilization techniques.
2. Microscopic methods in the identification of microorganisms.
3. Preparation of culture media- nutrient broth and nutrient agar.
4. Culturing of microorganisms- in broth and in plates (pour plates, streak plates, isolation and preservation of bacterial cultures).
5. Staining techniques – grams and differential.
6. Quantitation of microorganisms.
7. Effect of disinfectants on microbial flora.
8. Isolation and identification of microorganisms from different sources – soil, water and milk
9. Antibiotic sensitivity assay.
10. Growth curve – observation and growth characteristics of bacteria and yeast.
11. Effect of different parameters on bacterial growth (ph, temperature & UV irradiation.

Suggested Text Books:

i.) Talaron K, Talaron A, Casita, PelczarAnd Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.

ii.) Pelczar MJ, Chan ECS and Krein NT, Microbiology, Tata McGraw-Hill Edition, New Delhi, India.

iii.) Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1966.

BT- 112 **CELL BIOLOGY 4(3+1)Sem.I**

Unit I

Cell Structure and Function of the Organelles: Eukaryotic and prokaryotic cells, principles of membrane organization, membrane proteins, cytoskeletal proteins, type of cell division, mitosis & meiosis, extra cellular matrix, cell cycle and molecules that control cell cycle.

Unit II

Transport Across Cell Membranes: Passive & active transport, permeases, sodium potassium pump, Ca2+ ATPase, pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis. Entry of viruses and toxixns into cells.

Unit III

Receptors and Models of Extra Cellular Signalling: Cytosolic, nuclear and membrane bound receptors, examples of receptors, antocrine, paracrine and endocrine models of action, quantitation and characterization of receptors.

Unit IV

Signal Transduction: Signal amplification, different models of signals amplifications, cyclic amp, role of inositol phosphates as messengers, biosynthesis of inositol phosphates as messengers, biosynthesis of inositol tri phosphates, cyclic GMP and g proteins, role in signal transduction, calcium ion flux and its role in cell signaling, current models of signal amplification, phosphorylation

PRACTICALS:

1. Principles of microscopy, phase contrast and fluorescent microscopy.
2. Identification of given plant, animal and bacterial cells and their components by microscopy.
3. Leishman Staining,
4. Giemsa Staining,
5. Separation of Peripheral Blood Mononuclear Cells from blood,
6. Osmosis and Tonicity,
7. Tryphan Blue Assay,
8. Staining for different stages of mitosis in *Allium cepa* (Onion).

ME111 Heat& Mass Transfer 3(2+1) Sem.II

Unit I

Basic heat transfer process, thermal conductivity, convective film co-efficient and Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. One-dimensional steady state conduction: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian co-ordinates, linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines.

Unit II

One dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with uniform heat generation, Development of equations of temperature distribution with different boundary conditions. Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions.Effectiveness and efficiency of the FINS.

Unit III

Introduction to unsteady state heat conduction. Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient.

Unit IV

Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry.Fick's Law of diffusion, steady state diffusion of gases and liquids through solids.Equimolaldiffusion.Mass transfer co-efficient and problems on mass transfer.

Practical : Determination of thermal conductivity: milk, solid dairy & food products. Determination of overall heat transfer co-efficient of: Shell and tube, plate heat exchangers and Jacketted kettle used in Dairy & Food Industry. Studies on heat transfer through extended surfaces. Studies on temperature distribution and heat transfer in HTST pasteurizer. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on Mass Transfer

ME112 Fluid Mechanics and Hydraulics 3(2+1) Sem. I

Unit –I

Units and dimensions, Properties of fluids. Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure had of a liquid. Pressure on vertical rectangular surfaces.Compressible and non-compressible fluids.Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical guges, Piezometer.

Unit II

Floating bodies: Archimedes principle, stability of floating bodies. Equilibrium of floating bodies.Metacentric height. Fluid flow: Classification, steady uniform and non-uniform flow, Laminar and turbulent, continuity equation, Bernoulli's theorem and its applications. Flow through pipes: Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs, Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe.

Unit III

External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs.Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge.

Unit IV

Dimensional analysis: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude.Pumps : Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency.Types of chambers, selection and sizing.

Practical : Study of different tools and fittings. Plotting flow rate versus pressure drop with U-tube manometer. Verification of Bernoulli's theorem.Determination of discharge co-efficient for asteur, Orifice, V-Notch.Verification of emptying time formula for a tank. Determination of critical Reynold's number by Reynold's apparatus. Study of reciprocating, centrifugal and gear pump.Calibration of Rota meter.Study of different types of valves. Problems on following topics: Pressure, capillarity and surface tension. Floating bodies, Liquid flow, venturiemeter, orifice, weir, flow through pipes, pumps.

I Year II Semester B.Tech. (Bio-Technology)

Course No.	Title	Credit
Bioch-121	Biochemistry-II	3+0
Chem121	Bio-organic Chemistry	2+2
BT 121	Molecular Biology	3+2
BT122	Fundamentals in Industrial Biotechnology	3+2
Comp121	Fundamentals of Computing	2+0
Stat 121	Statistics	2+1

Bioch.-121 BIOCHEMISTRY-II 3(3+0)Sem.I

UNIT-I

Metabolism of Amino Acids: Nitrogen metabolism and urea cycle, Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met. Thr, Lys, IIe, Val, Leu) and regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feed back) from oxaloacetate and pyruvate; Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important moleculesderivedfromaminoacids (auxins, DOPA, Serotonin, Porphyrins, R3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc.)

UNIT-II

Protein Transport and Degradation: Protein targeting, signal sequence, secretion, Folding, Chaperons and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

Structural Proteins and Cytoskeleton: Contractile proteins, Actin, myosin, actin polymerization, acto-myosin complexes, ATPase activity, excitation – contraction coupling and relation, microtubules, microfilaments their role in organelle movements.

UNIT-III

Metabolism of Nucleic Acids, Polysaccharides and Lipids: Biosynthesis of nucleotides, denovo and salvage pathways for purines and pyrimidines, regulatory mechanisms: Degradation of cucleic acid by exo and endo nucleases. Biosynthesis and degradation of starch and glycogen, Biosynthesis and degradation of Lipids.Fatty acid synthesis and oxidative degradation, Triacylglycerol and phospholipids biosynthesis and degradation; Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs. Vitamins (fat and water-soluble), Co-enzymes, hormones (steroids like corticoids, amino acids derived like adrenaline and noradrenaline and peptides like insulin and growth hormone).

UNIT-IV.

Biomembrane, Transport and Electrical Conductivity: Micelles, lipid bi-layer structure of membranes, membrane proteins, passive, career-mediated and active transport, ion-selective channel, trans-membrane potential coupled ATP generation, receptors, acetylcholine receptor as a ligand ion-channel, Neuronal sodium channel as voltage gated ion channel, neurotransmitters and their mechanism of action, action potential, depolarization and nerve conduction, I on channel agonists and antagonists as drugs. Ion channel defects (cystic Fibrosis).

Chem.-121 BIOORGANIC CHEMISTRY 4(2+2) Sem.II

UNIT-I

Concept in Organic Chemistry: Stereochemistry- R, S notation-re-si faces- e, z isomerism, conformers, ethane, cyclopean, reactivates- mechanisms of sn 1, sn 2 reaction, ester formation and hydrolysis, reaction rates, Hammond's postulate, h/d effects, Catalysis- general acid base and covalent catalysis.

UNIT-II

Stereochemistry of Enzymatic Reaction: Stereo specific enzymatic reactions, furmarase catalyzed reaction, NAD dependent oxidation and reduction reaction, Stereochemistry of nucleophilic reaction, chiral methyl group, chiral phosphate.

UNIT-III

Case Studies of Enzyme Structure and Mechanism: The dehydrogenase, the proteases, rib nucleases, lysozym, stability, activity trade off.

Kinetics of Protein Folding: Basic method, two state kinetics, multistage kinetics, transition states in folding 1h/ 2h exchange methods, folding of peptides.

UNIT-IV

Folding Pathways and Energy Landscapes: Folding of ci2, nucleation condensation mechanism, folding of barnase, time resolution, insight from theory, optimization of folding rates, molecular chaperones.

PRACTICALS

1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha d- glucopyranose pent acetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of 1- praline
9. Preparation of 1- cysteine from hair
10. Preparation of s-ethyl hydroxybutonate from ethyl acetoacetate using yeast
11. Resolution of s-ethyl hydroxybutonate using 3,5 dinitrobenzoate
12. Preparation of 5,10,15,20- tetrakisphenyl porphyry

BT- 121 MOLECULAR BIOLOGY 5(3+2) Sem.II

Unit I

Classical Genetics: Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty,

Unit II

Bacterial conjugation, transduction and transformation; phage life cycle, mutation and repair of DNA.

Unit III

Structure of Nucleic acids and DNA Replication: Structure of DNA and RNA; replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome.

Unit IV

Transcription, Translation, Gene Expression: In prokaryotes and eukaryotes, features of promoters and enhancers, transcription factors, nuclear RNA splicing, ribozyme. Elucidation of genetic code, mechanism, codon usuage, suppressor mutation.Lac and trp operon.

PRACTICALS

1. Isolation of bacterial DNA.
2. Isolation of plant cell and animal cell genomic DNA.
3. Agarose gel electrophoresis.
4. Restriction enzyme digestion.
5. Competent cells preparation.
6. Transformation and screening for recombinants.
7. Blue and white selection for recombinants.
8. Plating of phage.
9. Induced mutations & Isolation of mutants.

BT- 122 FUNDAMENTALS IN INDUSTRIAL BIOTECHNOLOGY 5(3+2) Sem.II

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 process for various classes of secondary metabolites; antibiotics; beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.) macrolides (erythromycin), vitamins and steroids. Production of Enzymes and Other Bioproducts: Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc. Production of biopepesticide, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc.), single cell protein.

Unit IV

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.

PRACTICALS:

1. Production of Ethanol.
2. Production of Lactic acid using whey.
3. Production of protease- alkaline, neutral.
4. Production of biopesticides.
5. Production of biofertilisers.
6. Production of Nisin.
7. Visit to Bio- industry.

Comp.-121 FUNDAMENTALS OF COMPUTIN 2(2+0) Sem.II

UNIT I

Introduction: Introduction, Characteristics of Computers, the Evolution of Computers, The Computer Generations, Classification of Computers, Basic Computer Organization, Number System.

Computer Arithmetic and Software: Computer codes, Computer Arithmetic-Addition, Subtraction, Multiplication, Division; Computer Software, Types of Software, Logical System, Architecture, Software development Steps.

UNIT II

Problem Solving and Office Automation: Planning the Computer Program, Purpose, Alogrithm, Flow Charts, Pseudocode, Application Software Packages, Word processing, Spreadsheet, Graphics, Personal Assistance.

UNIT III

Introduction to C: Overview of C, Constants, Variables and Data Types, Operators and expression, Managing Input and Output Operators, Decision making and Branching, Decision making and Looping.

UNIT IV

Functions and Pointers: Arrays, Handling of Character Strings, User Defined Functions, Structures and Unions, Pointers, the Preprocessor, Developing a C program, Some guidelines.

Suggested text Books:

1. Pradeep, K. Sinha and PritiSinha, “Computer Fundamentals: Concepts, Systems and

Applications", BPB Publications, 2003.

2. E. Balagurusamy, "Programming in ANSI C", TMH, New Delhi, 2002.

3. Allen B. Tucker et.al., "Fundamentals of Computing I", TMH, New Delhi, 1998.

4. V. rajaraman, "Fundamentals of Computers", Prentice Hall of India, 2002.

5. Herbert Schidt, "C Made Easy", McGraw- Hill.

Stat.-121 STATISTICS 3(2+1) Sem.II

Probability and random Variables: Probability concepts, random variables, moment generating function, binominal, geometric, negative binomial, exponential, gamma, weibull distribution.

Two Dimensional Random Variables: Marginal and conditional distribution, covariance, correlation and regression, transformation of random variables, central limit theorem.

Random Process: Classification, stationary and markov processes, Poisson process, birth and death process, markov chains, markovian quenching models.

Reliability Engineering: Concept of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance.

Design of Experiments and Quality Control: Completely randomized design, randomized block design, Latin square design, process control, control charts of measurements and attributes, tolerance limits.

PRACTICALS:

1. Simple problems based on probability.
2. Problems based on binomial and Poisson distribution.
3. Problems based on geometric, negative binomial and exponential distribution.
4. Problems based on gamma, weibull distribution and reliability estimation.
5. Problems based on area tables of normal distribution.
6. Computation of simple correlation coefficient
7. Estimation of regression lines.
8. Test of significance of correlation and Regression coefficients.
9. Fitting of Markovian quenching model.
10. Analysis of CRD, RBD and LSD.
11. Construction of X & R charts. 12. Construction of ηp charts. 13. Construction of 'P' charts. 14 Construction of 'C' charts

II Year I Semester B.Tech. (Biotechnology)

Course No.	Title	Credit
BT 211	Genetic Engineering	3+2
BT 212	Bioprocess Principles	3+2
ME 211	Fundamentals of Biothermodynamics	2+0
ME 212	Principles Of Chemical Engineering	2+1
Phy 211	Biophysics	3+0
Comp 211	Computer Practice-I	0+1
Comp 212	Bioinformatics	2+1

BT- 211 GENETIC ENGINEERING 5(3+2) Sem.III

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. Applications of Recombinant DNA Technology:Cloning in plants, Food and Medicines.

Unit IV

Polymerase Chain Reaction: Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing – Sangers method, (Kunkel's Method).

PRACTICALS

1. Isolation & purification of plasmid DNA.
2. Elution of DNA from agarose gels.
3. Ligation of DNA into expression vectors.
4. Transformation.
5. SDS-PAGE.
6. Western blotting.
7. Hybridisation with anti-sera.
8. PCR.

BT-212 BIOPROCESS PRINCIPLES 5(3+2) Sem.III

Unit I

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

Materials and Media 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, Metabolic Stoichiometry and Energetics:: Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment – batch and continuous. 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 IV

Kinetics of Microbial Growth: Models 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.

PRACTICALS

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient.
2. Growth of yeast- estimation of biomass, calculation of specific growth rate, yield coefficient.
3. Medium optimization
4. Enzyme kinetics- MichelisMenton parameters.
5. Enzyme activity – effect of temperature and pH.
6. Enzyme inhibition kinetics.
7. Enzyme immobilization – gel entrapment and cross linking

ME- 211 FUNDAMENTALS OF BIOTHERMODYNAMICS (2+0) Sem.III

Unit I

Thermodynamic Properties of Fluids: Volumetric properties of fluids exhibiting non ideal behaviour; 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 Equilibria: Criteria for phase equilibria; v-l-e calculations for binary ands multi component systems; liquid-liquid equilibria and solid-solid equilibria.

Chemical Reaction Equilibria: Equilibrium criteria for homogeneous chemical reactions; equlation 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.

Suggested Text Books

i.) Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics. 6th Edition. McGraw – Hill, 2001.

ii.) Narayanan K.V. A Text Book of Chemical Engineering Thermodynamics. Prentice Hall India, 2001.

iii.) Sandler S.I. Chemical and Engineering Thermodynamics. John Wiley, 1989.

ME- 212 PRINCIPLES OF CHEMICAL ENGINEERING (2+1) Sem.III

Unit I

Overview of Process Industry: Mass and energy conservation; process automation; environment; SI unit; conservation factors; applied mathematics for experimental curve fitting; numerical differentiation; integration.

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 II

First and Second Laws of Thermodynamics: Energy balances; sensible heat, latent heat; vapour pressure; steady and unsteady state calculations.

Unit II

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

Unit IV

Flow Through Packed Columns: Fluidization; centrifugal piston pumps; characteristics; compressors; work.

PRACTICALS:

Based on theory.

Phy.-211 BIOPHYSICS 3(3+0) Sem.III

Unit I

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

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

Unit III

Kinetics of Ligand Interactions: Biochemical Kinestics studies, Unimolecular reactions, simple biomolecular multiple intermediates, steady state kinetics, catalytics efficiency, relaxation spectrometry, ribonuclease as an example.

Unit IV

Techniques for the Study of Biological Structure & Function: Size and shape of macromolecules-methods of direct visualization-macromolecules as hydrodynamic particles-macromolecular diffusion-ultracentrifugation-viscometry x-ray crystallography determination of molecular structures, X-ray fibre diffraction electron microscopy neutron scattering-light scattering.

Comp.-211 COMPUTER PRACTICE - 1 (0+1) Sem. III

LIST OF EXPERIMENTS

UNIT-I

Word processing:

1. Document creation, text manipulation with Scientific notations.
2. Table creation, table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing- Flow Chart.

Spread Sheet:

1. Chart- Line, XY, Bar and Pie.
2. Formula- formula editor.

UNIT-II

Simple C Programming

1. Data types, expression Evaluation, Condition Statements.
2. Functions, recursion and parameter passing mechanism.
3. Arrays.

UNIT-III

1. Structures and Unions.
2. Pointers and Functions.
3. File Processing.
4. Dynamic Allocation & Linked List.

Comp. - 212 BIOINFORMATICS (2+1)Sem. III

THEORY:

UNIT-I

Introduction: Basic UNIX commands – telnet 0 ftp – protocols – hardware – topology – search engines - search algorithms.

Databases: Data management – data life cycle – database technology – interfaces and implementation – biological databases and their uses.

UNIT-II

Pattern Matching & Machine Learning: Pair wise sequence alignment – local vs. global alignment – multiple sequence alignment – dot matrix analysis – substitution matrices – dynamic programming – Bayesian methods – tools – BLAST – FASTA – machine learning – neural networks – statistical methods – Hidden Markov models.

UNIT-III

Phylogeny: Introduction; mutations; irrelevant mutations; controls; mutations as a measure of time; distances; reconstruction; distances between species; estimating time intervals from distances.

UNIT-IV

Advanced Topics In Bioinformatics: Biomolecular and cellular computing – micro array analysis – systems biology.

PRACTICALS:

1. Learn basic Unix commands.
2. Relation databases with MS- Access.
3. Become familiar with the various web sites that allow access to the sequence databases.
4. Become familiar with the one letter sequence codes for nucleiotides (components of RNA and DNA) and amino acids residues (components of proteins)
5. Become familiar with and understand the differences between the sequence formats required by these databases.
6. Understand the similarities and differences between the inputs and outputs of the sequence databases.
7. Learn to find specific (assigned) sequences in each databases.
8. Become familiar with websites that allow access to pair wise sequences alignment programs.
9. Understand the difference between global and local sequence alignment.
10. Determine the algorithms underlying the sequence alignment programs.
11. Use several of these programs to obtain reasonable output.
12. Learn to critically evaluate the output from these programs.

II Year II Semester B.Tech. (Bio-Technology)

Course No.	Title	Credit
BT-221	Bioprocess Technology	3+2
BT-222	Enzyme Biotechnology	3+2
BT-223	Biotechnology in Food Processing	2+1
BT-224	Instrumentation in Biotechnology	2+2
Comp-221	Computer Practice-II x	0+1
ES-221	Principles of Environmental Science	3+1

BT-221 BIOPROCESS TECHNOLOGY 5(3+2) Sem. IV

Unit I

Principles and functions of stirred tank reactor- Design of continuous sterilizer; Packed bed reactor, fluidized bed reactor bubble column reactors – non-ideality, RTD and stability analysis. Stirred tanks in series and dispersion models – application to design of continuous sterilizer.

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

Bioprocesses Modelling and Simulation: 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 IV

Bioreactor Consideration in Enzyme Systems: Immobilization and kinetics of enzymes and reactions;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.

PRACTICALS

1. Thermal death kinetics.
2. Batch sterilization design.
3. Fed batch cultivation.
4. Estimation of overall heat transfer coefficient.
5. Continuous cultivation- carbon balancing, gas balancing.

BT- 222 ENZYME BIOTECHNOLOGY 5(3+2) Sem. IV

Unit I

Introduction to Enzymes and Kinetics of Enzyme Action: Classification of enzymes, Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catelysis – collision theory, transition state theory, role of entropy in catalysis.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 changeuxwyman model, ph and temperature affect on enzymes & deactivation kinetics.

Unit II

Enzyme Immobilization: Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages; types of detoxifying enzymes, functions and applications in food industry.

Unit III

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 IV

Enzyme Biosensors: Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

PRACTICALS:

1. Isolation of protease producing
2. Production of enzyme (Protease) in shake flask and lab fermenter.
3. Effects of different environmental factors on enzyme production.
4. Enzyme immobilization; encapsulation.
5. Purification of crude enzyme by Ammonium Sulphate precipitation, gel filtration, dialysis, ion exchange chromatography
6. Enzyme assay.

BT- 223 BIOTECHNOLOGY IN FOOD PROCESSING3(2+1)Sem. IV

Unit I

Role of Biotechnology in Food Processing: History and **contemporary role of** Biotechnology in relation to the food industry, nutritive value of food types of microorganisms associated with food, its sources, functions and types in foods.

Unit II

Chemical, genetic and enzymatic modifications of proteins and their functions. Recent developments in enzyme technology to food processing- biocatalysts.

Unit III

Application of enzymes in bioprocessing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing, biochemical engineering for flavour and food production.

Unit IV

Genetically Modified Foods: Food borne illness, quality control, case studies on Biotechnology in the evolution of food quality, HFCS (High Fructose Corn Syrup) and microbial proteins; Utilization of microorganisms in food and agriculture industry and their impacts.

PRACTICALS:

1. Enumeration and detection of microorganisms associated in foods.
2. Biochemical synthesis of flavour compounds.
3. Biochemical analysis of genetically modified foods.
4. Analysis of Biochemical channels in fermented foods- cheese, yoghurt.
5. Production, purification of exopolysaccharides using fermenter.

BT- 224 INSTRUMENTATION IN BIOTECHNOLOGY 4(2+2)Sem. IV

THEORY

Unit I

Basic of Measurement: Classification of methods – calibration of instrumental methods –electrical components and circuits – signal to noise ratio – signal – noise enhancement.

Unit II

Optimal Methods: General design – sources of radiation – wavelength selectors – sample containers – radiation transducers – types of optical instruments – Fourier transform measurements.

Unit III

Molecular Spectroscopy: Measurement of transmittance and absorbance – Beer's law – spectrophotometer analysis – qualitative and quantitative absorption measurements – types of spectrometers – UV – visible – IR – Raman spectroscopy – instrumentation – theory.

Unit IV

Molecular Methods: Thermocyclers, sequences, gel- electrophoresis, electroporation, gene gun, gel documentation, Introduction to chromatography- gas chromatography van- deemeter equation – gas chromatography, HPLC, ion exchange chromatography – size exclusion chromatography , column chromatography, capillary electrophoresis, gradient separation- gel filtration; models- ideal separation- retention parameters- van- deemeter equation.

PRACTICALS

1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer's law using kmno4.
3. Finding the molar absorbtivity and stoichiometry of the Fe (1, 10 phenanthroline) 3 using absorption spectrometry.
4. Finding the pKa of 4-nirophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chromatography analysis using TLC.
7. Chromatography analysis using column chromatography, gas chromatography & HPLC.
8. Standardization of thermocycler.
9. Use of gel documentation system.

Comp.-221 COMPUTER PRACTICE – II(0+1)Sem. IV

LIST OF EXPERIMENTS

Unix Commands

Study of Unix OS, Basic Commands, Process management Commands, Unix Editor.

Shell Programming

i) Simple Shell Program, Conditional Statements, testing and Loops

ii) Commands line substitution

C Programming and File Management

C program to implement Unix Commands

Process management and Signal Handling

Programs in C for Signal handling and process Management

ES-221 PRINCIPLES OF ENVIRONMENTAL SCIENCE 4(3+1) Sem. IV

THEORY

UNIT-I

Introduction to environmental Studies and Natural Resources: Definition, Scope and importance- need for public awareness forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground, floods, drought, conflict over water, dams-benefits and problem-mineral resources; use effects on forest and tribal people-water resources; use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies-food resources: world food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer pesticide problems, water logging, salinity, case studies- energy needs, renewable and non-renewable energy sources. Case studies-land resources; land as resource, land degradation, man included land slides, soil erosion and desertification- role of an individual in conversation of natural resources- equitable use of resources for sustainable life styles. Field study of local area to document environmental assets-river/ forest/ grassland/ hill/ mountain.

UNIT-II

Ecosystem and Biodiversity: Concept of an ecosystem-structure and function of an ecosystem- producers, consumer and decomposers- energy flow in the ecosystem- ecological succession- food chains, food web and ecological pyramids- introduction, types, characteristic features, structure and function of the (a) forest ecosystem, (b) grassland ecosystem, (c) desert ecosystem, (d) aquatic ecosystem (pond, streams, lakes, rivers, oceans, estuaries)- introduction to biodiversity- definition; genetic, species and ecosystem diversity- biogeographically classification of India- value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values- biodiversity at global, national and local levels- India as a mega-diversity nation- hot spots of biodiversity- threat to biodiversity; habitat loss, poaching of wildlife, man-wildlife conflicts-endangered and endemic species of India- conservation of biodiversity: in situ and ex-situ conversation of biodiversity. Field study of common plants, insects, birds. Field study of simple ecosystem- pond, river and hill slopes etc.

UNIT-III

Environmental Pollution: Definition- causes, effects and control measures of **(**a) air pollution, (b) water pollution, (c) soil pollution, (d) marine pollution, (e) noise pollution, (f) thermal pollution, (g) nuclear hazards. Soil waste management: cause, effects and control measures of urban and industrial wastes- role of an individual in prevention of pollution- pollution case studies, disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site- urban/ rural/ industrial/ agricultural.

Social Issues and the Environment: From unsustainable to sustainable development- urban problems related to energy- water conservation, rain water harvesting, watershed management- resettlement and rehabilitation of people; its problems and concerns, case studies. Environmental ethics: issues and possible solution- climate changes, global warming, acid rain, ozone layer depletion, nuclear accident and holocaust, case studies- waste land reclamation. Consumerism and waste products- Environment Pollution Act- Air (Prevention and Control) Act, Water (Prevention and Control) Act, Wildlife Protection Act, Forest conservation Act: Issues involved in enforcement of environment legislation, public awareness.

Human Population and the Environment: Population growth, variation among nation population explosion, family welfare programme, environment and human health, human rights, value education, HIV AIDS, Women and Child welfare, Role of information technology in environment and human health, case studies.

PRACTICALS:

1. Visit to local polluted area and collect the information about water, air, soil, plants, geography, etc.
2. Study of general plants, pests and birds.
3. Study of simple ecosystem Hill slope, pond, lake, river etc.
4. Bhopal Tragedy Gas pollution: A case study.
5. Tsunami: A case study.
6. Gujarat Earthquakes: A case study.
7. Orrisa cyclone: A case study.
8. Rajasthan Drought 2000-01: A case study.
9. Study about non-conventional energy appliances.

III Year I Semester B.Tech. (Biotechnology)

Course No.	Title	Credit
BT 311	Downstream Processing	2+2
BT 312	Biotechnological Applications In Fermented Foods	2+2
BT 313	Protein Structure & Bioengineering	3+0
BT 314	Plant Biotechnology	2+2
MS 311	Total Quality Management	3+0
MS 312	Project Management & Entrepreneurial Development	3+1

BT- 311 DOWNSTREAM PROCESSING (2+2) Sem. V

THEORY

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 stabilization of bioproducts. Physical Methods of Seperation:Unit operations for solid-liquid separation – filtration and centrifugation.

Unit II

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

Unit III

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

Unit IV

Final Product Formation and Finishing Operations: Crystallization, drying and lyophilization in final product formulation.

PRACTICALS

1. Solid liquid separation – centrifugation, micro filtration.
2. Cell disruption techniques – ultrasonication.
3. Ammonium sulphite precipitation and dialysis.
4. Product polishing – gel filtration chromatography.
5. High resolution purification – affinity chromatography.

6. Aqueous two phase extraction of biologicals.
7. Ultra filtration separation.
8. Product polishing – spray drying, freeze drying.

Suggested Text Books

i.) P.A. Belter, E.L. Cussler and Wei-Houhu – Bioseparations - Downstream Processing For Biotechnology, Wiley Interscience Pub. (1988).

ii.) R.O. Jenkins, (Ed.) – Product Recovery in Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth – Heinemann (1992).

BT- 312 Biotechnological Application in Fermented Foods4(2+2) Sem. V

THEORY

Unit I

History development and importance of fermented foods in human diet; development of flavour, production of vitamins.Types of microorganism involved in fermentation process bacteria, yeast and mold and their role.Biotechnlogical methods in development of fermented foods.

Unit II

Genetic improvement of starters of fermentation, election of starter cultures and strains; development of phage, antibiotic resistant starters. Biochemical changes in fermented foods- ripening of change, fermentation in yoghurt, dahi, acidophilis milk etc.

Unit III

Fermented changes in vegetables, pickles, sauerkraut silage, meat, fish, bread, legume and cereal foods, beverages and plant products. Single cell protein, production from agro wastes, microorganism, algae and the nutritional value.

Unit IV

Food spoilage and food borne illness: common spoilage in dairy, meat, poultry, plant products, food poisoning and toxins, newly emerging pathogens.

PRACTICALS:

1. Isolation, screening of bacteriocins, producing lactic acid bacteria- nisin, acidophilin etc.
2. Production of fermented foods using normal and recombinant- phage, antibiotics/ pesticides- resistant starters.
3. Production of beverages, plant products using microbial cultures.
4. Production of single cell protein from agro wastes algae etc.
5. Application of lactase, proteases in the fermentation of fermented products.

BT- 313 PROTEIN STRUCTURE AND BIOENGINEERING 3(3+0) Sem. V

THEORY

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, visiblse, 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; peptide mapping, peptide sequencing – automated Edman method & mass-spec. High-throughput protein sequencing set up 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 site

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

Unit IV

Structure-Function Relationship: DNA- binding proteins; prokaryotic transcription factors, Helic-turn-Helic motif in DNA binfinh, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helic 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 elastage, substrate-assisted catalysis other commercial applications.

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.

Suggested Text Books

i) Voet and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
ii) Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999.
iii) Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.
iv) Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1990.

BT- 314 PLANT BIOTECHNOLOGY 4(2+2) Sem. V

Unit I

Plant Tissue Culture and Applications: history of plant cell and tissue culture; Culture media; *in vitro* tissue culture via apical and axillary's meristem, callus culture, somatic embryogenesis, Anther/ microspore culture; Somaclonal variation; synthetic seeds, embryo rescue, protoplast culture; somatic hybridization: protoplast fusion, hybrids.

Unit II

Transgenic Technology: Various methods of plant transformation; types of vectors for plant transformation; Genetic and molecular analyses of transgenics; transgenics for biotic and abiotic stress.

Unit III

Molecular Marker Technology: Application of PCR in plants; Types of molecular markers in plant system, i.e., RFLP, RAPD, SSR, SNPs etc., application of molecular markers; DNA sequencing.

Unit IV

Applications and Issues of Agricultural Biotechnology: genera applications of biotechnology in agriculture, introduction of biosafety issues in agricultural biotechnology, regulatory procedures for commercial approval of genetically engineered plants.

PRACTICALS:

1. Laboratory set up.
2. preparation of nutrient media; handling and sterilization of plant material; inoculation, sub-culturing and plant – regeneration.
3. Anther and pollen culture.
4. Method of *Agrobacterium* mediated genetic transformation; reporter gene expression; selection of transformed tissues/ plants and molecular analysis.
5. Tissue culture techniques for vegetative propagation &metabolites.

MS- 311 TOTAL QUALITY MANAGEMENT(3+0)Sem. V

Introduction: Definition of Quality, Dimensions of Quality Planning, Quality costs- Analysis techniques for Quality costs, Basic concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming philosophy, Barriers to TQM implementation.

TQM Principles: Customer satisfaction- Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement- Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous process Improvement- JuranTriology, PDSA Cycle, SS, Kaizen, Supplier Partnership- Partnering sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures- Basic concepts, Strategy, Performance Measures.

Statistical Process Control (SPC): The seven tools of quality, Statistical fundamentals- Measures of Central Tendency and Dispersion. Population and Sample, Normal curve, Control charts of Variables and Attributes, Process Capability, Concept of Six Sigma, New seven Management Tools.

TQM Tools: Benchmarking- Reasons to Benchmark, Benchmarking Process, Quality Function Development (QFD)- House of Quality, QFD Process, Benefit, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)- Concept Improvement Needs, FMEA- Stages of FMEA.

Quality Systems: Needs for ISO-9000 and other quality systems, ISO- 9000:2000 Quality System- Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO: 14000- Concept, Requirement and Benefits.

MS- 312 PROJECT MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT (2+1)

THEORY

UNIT-I

Project Management

Plans & Projects: Projects in Public Sector and Private Sector.

Project Formulation: Essential features, Project & Final Drafting

Appraisal of projects (Analysis): Market appraisal, Technical appraisal, Organization appraisal, Economic appraisal, Criterion for project appraisal pay back, ARR, NPV, IRR, Treatment of Risk & Uncertainty, Sensitivity Analysis.

Social Cost Benefit (SCBA) approach in project appraisal: Shadow price, Rate of discount, wages rates, Exchange rates, Valuation of indirect and intangible costs and benefit. Taxes and subsidies, Merit & Servant goods.

Environmental Appraisal of projects; Evaluation & Selection of projects: Management of Projects, Project Planning, Project Scheduling, Project Organization, Resource Management, Project monitoring & control.

Entrepreneurship Development

UNIT-II

Management as a discipline: Manager, Managerial Function, Planning , Organizing, Staffing, Budgeting, Coordinating, Directing and Controlling, Responsibility, Authority,

Power, Decentralization of Authority.

UNIT-III

Human & Organizational Behaviour: Theory x and Theory y.

Human resource Management: Concept & Principle; Difference between HRM & Personnel Management; Human Resource Policy, HR Procurement, Recruitment and Selection, Transfer & Promotion; Job enrichment & Job Enhancement,, performance appraisal, Job evaluation, Grievances Handling system, Moral & Productivity.

Motivation: Meaning, Characteristics, Content Theories.

Leadership: Traits, Styles, Grid, Leadership effectiveness.

UNIT-IV

Entrepreneurship Development

Definition, Concept and Importance, Characteristics; Types of entrepreneurs; Qualities and qualification of good entrepreneur, Factors determining the development of entrepreneurship, Entrepreneurship Education & Training; Obstacles in the development of entrepreneurship.

PRACTICALS:

1. Market analysis for demand forecasting of milk.
2. Preparation of techno-economic analysis report for small, medium scale food pharma industries.
3. Preparation of techno-economic analysis report for large scale food pharmaceutical industries.
4. Scheduling and Networking of milk processing operations.
5. Scheduling of information needed for setting up a new Dairy Plant.
6. Scheduling of information needed for **extension of present Dairy Plant.**

III Year II Semester B.Tech. (Bio-Technology)

Course No.	Title	Credit
BT-321	Fundamentals of Immunology	2+2
BT-322	Molecular Pathogenesis	3+0
BT-323	Pharmaceutical Biotechnology	3+2
BT-324	Molecular Modeling & Drug Design	3+0
BT-325	Environmental Biotechnology	3+1
MS-321	Bioprocess Economics & Optimization	3+1

BT- 321 FUNDAMENTALS OF IMMUNOLOGY4(2+2) Sem.VI

THEORY

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 immunization; Vaccines.

Unit IV

Transplantation and Tumor Immunology: Transplantation: genetics of transplantation; laws of transplantation; tumor immunology.

Autoimmunity: Autoimmunity, Autoimmune disorders and diagnosis.

PRACTICALS

1. Handling of animals, immunization and raising antisera.
2. Identification of Cells in a blood smear.
3. Identification of blood group.
4. Immuno-diffusion &immuno-electrophoresis.
5. Testing for typhoid antigens by Widal test.

6. Enzyme Linked Immuno -orbent Assay (ELISA).
7. Isolation of peripheral blood mononuclear cells.
8. Isolation of monocytes from blood.
9. Immuno-fluorescence.
10. Idenetification of t cells by T-cell rossetting using sheep RBC.

Suggested Text Books:

i) Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
ii) Kuby J, Immunology, WH Freemen & Co., 2000.
iii) Ashim K. Chakravarthy, Immunology, Tata Mcfgraw-Hill, 1998.

BT- 322 MOLECULAR PATHOGENESIS 3(3+0) Sem.VI

THEORY

Unit I

Introduction to pathogensis, attributes of microbial pathogenesity, components of microbial pathogenicity.

Unit II

Population genetics of Microbial pathogenesis, genetic diversity and structure in nature, population epidemiology, cryptic diseases.

Unit III

Host defences against pathogens, clinical importance of understanding of host defences, components of the host surface defences systems like, mucosa and the defences systems of the eye, mouth, respiratory tract etc., components of the systemic defence like the tissues and blood.

Unit IV

Virulence and virulence factors, colonizing virulence factors, virulence factors damaging the host tissues.

Paradigms of Pathogenesis

a) Diphtheria disease by colonization.
b) Disease without colonization, C. Botulinum and Staph. aureus.
c) Cholera.
d) Intestinal infections, Shigella and E.coli infections.
e) Salmonella infections
f) Fungal infections

Future Challenges

a) Gastric and duodenal ulcers are they due to infections.
b) Lyme disease and Syphills-unsolved mystery.
c) Legionnaire's disease-aftermath of comforts.
d) Tuberculosis and other mycobacterial infection-re-emerging with vengeance
e) Rheumatic fever and glomerulonephrits still a question to be solved.

Suggested Text Books

i) Iglewski B.H. and Clark V.L. "Molecular basis of Bacterial Pathogenesis", Academic Press, 1990.
ii) Talaro K. and Talaro A, "Foundations in Microbiology", W.C. Brown Publishers, 1993.
iii) Roitt I, "Essentials of Immunology, 8th edition", Blackwell Scientific Publishers, 1994.
iv) Janeway C.A. Jr. and Travers P.T. "Immunobiology", Blackwell scientific Publishers, 1994.
v) Austyn. J.M. Wood K.J. "Principles of Cellular and Molecular Immunology", Oxford University Press, 1993.

BT- 323 PHARMACEUTICAL BIOTECHNOLOGY 5(3+2) Sem.VI

THEORY

Unit I

Introduction: Development of Drug and Pharmaceutical Industry- Therapeutic agents, their uses and economics; Regulatory aspects. Drug Metabolism and Pharmacokinetics:Drug metabolism-physico chemical principles, radioactivity-pharma kinetics-action of drugs on human bodies.

Unit II

Important Unit Processes and their Applications: Bulk drug Manufactures, Types of Reactions in Bulk drug Manufacture and Processes. Special Requirements for Bulk Drug Manufacture.

Unit III

Manufacturing Principles: Compressed tables, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules sustained action dosage forms-parental solutions-oral liquids-injections-ointments-Topical Application, Preservation, analytical methods and test for various drugs and pharmaceuticals, Packaging-Packing Techniques, Quality Management, GMP.

Unit IV

Pharmaceutical Products and their Control: Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, biological, hormones.

PRACTICALS:

Based on theory.

Suggested Text Books.

i) Leon Lachmantet al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986.

ii) Remington's Pharmaceutical Sciences, Mark Publishing and Co.

BT- 324 MOLECULAR MODELING AND DRUG DESIGN 3(3+0) Sem.VI

Unit I

Empirical Force Fields Molecular Mechanisms: Bond Stretching-Angel Bending-Torsional terms- Out of Plane bonding motions-Electrostatic interactions-Van Der Waals interactions-Effective pair Potentials-Hydrogen Bonding-simulation of liquid water.

Computer Simulation Methods: Calculation of thermodynamic properties- Phase space-Practical aspects of computer simulation-Boundaries monitoring Equilibrium-Long range process-Analysing results of simulation and estimating errors.

Unit II

Molecular Dynamics Simulation Methods: Molecular Dynamics using simple modules-Molecular Dynamics with continuous potentials-running Molecular Dynamics simulation-constant dynamics-Time dependent properties-Molecular Dynamics at constant temperature and pressure.

Unit III

Monte Carlo Simultion Methods: Metropolis methods-Monte Carlo simulation of molecules- Monte Carlo simulation of polymers-Calculating chemical potentials- Monte Carlo or Molecular Dynamics.

Unit IV

Molecular Modelling to Discover and Design New Molecules: Molecular modeling in drug discovery-Depriving and using 3D Pharma cores-Molecular docking-Structure Based methods to identify lead components-Denovo ligand design.

Suggested Text Books:

i) A.R. Leach, "Molecular Modelling Principles and Applications", Longman, 1996.
ii) J.M. Haile, "Molecular Dynamics Simulation Elementary Methods". John Wiley and sons, 1997.
iii) GROMOS 95 Manual, BIOMOS Switzerland, 1995.
iv) HYPERCHEM Manual typercube Canada, 1995.

BT- 325 ENVIRONMENTAL BIOTECHNOLOGY 4(3+1) Sem.VI

THEORY

Unit I

Basic Concepts and Environmental Issues: Types of environmental pollution; problems arising from high-inpt agriculture; methodology of environmental management; air and water pollution and its control; waste water treatment- physical, chemical and biological processes; need for water and natural resource management.

Unit II

Microbiology and Use of Micro-organisms in Waste Treatment: Biodegradation; degradation of Xenobiotic, Surfactants, bioremediation of soil & Water contaminated with oils, Pesticides & toxic chemicals, detergents etc. Aerobic process (activated sludge, oxidation ditches, trickling filter, rotating drums, etc.); anaerobic processes: digestion, filtration etc.

Unit III

Renewable and Non Renewable Resources and Industrial Effluents: energy from solid waste conventional fuels and their environmental impact; biogas; microbial hydrogen production; conversion of sugar to alcohol, gasohol, biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

Unit IV

Treatment schemes of Domestic Waste and Industrial Effluents: Management of agriculture, food feed, pharmaceutical and urban soild and liquid waste; energy from soild waste; bioleaching; enrichment of ores by microorganisms; global environmental problems: ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation; biotechnological approaches for the management of environmental problems.

PRACTICALS:

1. Collection of solid waste, water and samples and microbial analysis.
2. Physicochemical properties. BOD & COD of waste water.
3. Biochemical & microbiological analysis of solid and liquid wastes from Food industry, pharmaceutical industry, sugar industry, beverage & brewery industries.
4. Bioremediation of contaminated raw materials used in fermentation, food, feed, pharmaceutical, agricultural industries.

Suggested Text Books:

i) Evans, G.M. & Furlong, J.C. 2002.*Environemtal Biotechnology: Theory and Application.* Wiley Internaitonal.

ii) Jorden, H.J. & winter, J. 2006. *Environmental Biotechnology: Concepts and Applications.* Wiley- VCH Verlag.

MS- 321 BIOPROCESS ECONOMICS AND OPTIMIZATION4(3+1) Sem.VI

THEORY

UNIT-I

Economics and commercial factors influencing the role of biotechnology in the food, agriculture and pharmaceutical industries.

Process Design Development: Technical feasibility survey, process development, flow diagram, equipment design and specifications.

UNIT-II

General Design Consideration: Marketability of the product availability of technology, raw materials, equipments, human resources, land & utilities, site characteristics, waste disposal, govt. regulations and other legal restrictions, community factors and other factors affecting investment and production cost.

UNIT-III

Cost estimation: Capital investment-fixed capital investments including land, building, equipments and utilities, installation cost (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investment, Manufacturing cost- Direct production cost (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.) fixed charges (including depreciation, taxes insurance, rental cost etc.),

UNIT-IV

Plant overheads- Administration, safety and auxiliary services, payroll overhead, ware house and storage facilities etc. Profitability analysis- return on original investment, interest rate of return, accounting for uncertainty and variations and future developments, Optimization techniques- Linear and Dynamic programming, Optimization strategies.

PRACTICALS: Based on theory.

IV Year I Semester B.Tech. (Biotechnology)

Course No.	Title	Credit
BT 411	Introduction to Nano-Biotechnology	2+0
BT 412	Immunotechnology	3+1
BT 413	Credit Seminar	0+2
MS 411	Bio-safety, Intellectual Property Rights & Bioethics	3+0
MS 412	Financial Management	3+1
MS 413	Cost Accounting & Control	2+0
MS 414	Marketing Management & International Trade	3+0
MS 415	Operational Research	2+1

BT-411 INTRODUCTION TO NANO-BIOTECHNOLOGY 2(2+0) Sem.VII

THEORY

UNIT-I

Introduction of Nano-Biotechnology: History , introduction, definition of nano-biotechnology, biotechnological approaches with nanoscience.

UNIT-II

Properties of biomaterials: Chemical, physical and biological properties of biomaterials, properties of natural materials (proteins, DNA and polysachharides and phospholipids), structure- property relationships in polymeric materials.

UNIT-III

Nano-particles and uses: preparation and characterization of nano particles; nanoparticular carrier systems; Drug and gene delivery system; biosensors, Chip technologies, Nano-imaging etc.

UNIT-IV

Application of nano-biotechnology: Application of nano-biotechnology in agriculture, medicine, future prospects of nano-biotechnology.

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BT-412 IMMUNOTECHNOLOGY4(3+1) Sem.VII

THEORY

UNIT-I

Antigens: types of antigens, their structure, preparation of antigen for raising antibodies, handling of animals, adjuvants and their mode of action.

Antibodies and Immunodiagnosis:

Monoclonal and polyclonal antibodies- their production and characterization, western Blot Analysis, Immunoelectrophoresis, , SDS PAGE, Purification and synthesis of antigens, ELISA- principles and application, radiommuno assay (RIA)- principles and applications, non isotopic methods of detection of antigens- enhanced chemiluminescence assay.

UNIT-II

Assessment to Cell Mediated Immunity: Identification of lymphocytes and their subsets in blood. T Cell activation parameters, estimation of cytokins, macrophages, activation. Macrophage microbial assays, in vitro experimentation- application of the above technology to understand the pathogenesis of infection diseases.

UNIT-III

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- immunofluoroscence, immunoenzymatic and immunoferritin techniques, immunoelectron microscopy.

UNIT-IV

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

Current topics in Immunology: Trends in immunology of infectious diseases and tumours, topics as identified from time to time.

PRACTICALS

Based on Theory.

BT -413 Credit Seminar 0+2

MS- 411 Biosafety, Intellectual Property Rights and Bioethics 3(3+0) Sem.VII

THEORY:

Unit I

Introduction to biosafety, IPR and biosafety: Biosafety and risk assessment issues; regulatory framework; National biosafety policies and law; The Cartagena protocol on biosafety, WTO and other international. Agreements related to biosafety, Cross border movement of germplasm; Risk management issues- containment.

Unit II

Understanding of biosafety: General principles for the laboratory and environmental biosafety, health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; creation of super weeds/ super viruses etc. Biosafety regulation and national and international guidelines.

Unit III

Bioethics and Impact of Technology on Environment and Society: ecological aspects of GMOs and impact on biodiversity; monitoring strategies and methods for detecting transgenics; Benefits of transgenics to human health, society and the environment.

Unit IV

Intellectual property Rights and laws: Indian position v/s WTO and strategies, other international agreements; Indian IPR legislations, commitments to WTO- Patent Ordinance and the Bill-Draft of a national Intellectual Property Policy – Protection against Unfair Competition; Intellectual Properties, Copyrights, Trademarks, Trade Secrets, Patent Act and amendments, Patent filing; Convention on biological Diversity; Implications of IPR on the commercialization of biotechnology products; Case studies on- Patents (basmati rice, turmeric, neem, etc.)- copyright and related rights- trade marks, Industrial design and integrated circuits, protection against unfair competition.

MS- 412 FINANCIAL MANAGEMENT(2+1)Sem.VII

THEORY

UNIT-I

Introduction: Definition, scope and Objectives of Financial Management

Different System of Accounting: Financial Accounting, Cost Accounting, Management Accounting.

Double entry system of Book Keeping.

Preparation Accounting Records: Journal, Purchase and Sales book and Posting in Ledger, Cash Book.

Preparation of Final Accounts and Adjustment at the end of the Trading Period.

Preparation of Trail Balance.

Banking Transactions and Bank Reconciliation Statements.

UNIT-II

Statements of Financial Information: Accounting System: A source of financial statements, Classification of capital and revenue expenditure, Balance sheet, Profit and Loss account , Statement of changes in the financial position.

Fund flow statement, Cash flow statement, Uses of funds flow and cash flow statements in financial decision making.

Financial Analysis: Nature & uses of financial analysis, Liquidity ratios, Activity ratios, Profitability ratios, Utility of Ratios analysis.

UNIT-III

Cost volume profit analysis and operating leverage

Break even analysis, Profit analysis and operating analysis, Utility of CVP analysis.

Capital Structure: C.S. Planning, risk return trade off, financial leverage.

Cost of Capital: Management of cost of capital, cost of debt, debentures, preference shares capital equity share capital & Retained earning, Overall cost of capital.

Investment decisions: Time value of money, Net present values, Investment evaluation criteria. NPV method, Internal rate of return method, Profitability Index method, Pay back period method, Accounting rate return method.

Capital Budgeting.

UNIT-IV

Work Capital Management: Concept & determinants of working capital.

Auditing: Meaning, objectives & procedure.

Depreciation: Concept & Method.

PRACTICALS:

1. Preparation of profit & loss account and Balance sheet.
2. Preparation of cash and Fund Flow Statements
3. Problem of ratio Analysis
4. Problem on Break-even Analysis and profit Analysis
5. Problem on Operating leverage Analysis and Financial leverage
6. Problem on Cost of Capital
7. Problem on Investment decision
8. Problem on Capital Budgeting
9.

MS- 413 COST ACCOUNTING AND CONTROL (2+0)Sem.VII

THEORY

UNIT-I

Introduction: Definition, Objectives, Common terms in Cost Accounting

Costing: Essential of Sound Costing system, Different Methods of costing.

Element of Cost: Labour- recording of time, idle time, methods of remunerating, labour, premium & bonus plans, Materials, Overhead.

UNIT-II

Cost classification: Direct & Indirect Expenses, Fixed & variable, Various Methods of apportioning indirect expenses.

Inventory Management: Planning Control & Costing; Store & Storekeeping, Scope & Importance; Purchase procedure; Types of Purchase; Location of stores & Materials, Procedure for the movement of stores; Different methods of pricing materials, store record.

UNIT-III

Cost Sheets: Different methods.Statement of cost and Statement of profit.Estimates, Tenders or Quotations.Contract or Terminal Costing**.**Process Costing:Process losses and inter processes profits; Joint products and by- products costing.

UNIT-IV

Preparation of Cost Accounting information for Managerial decision making. Cost information as a base for price fixation in given markets as per objectives. Ascertainment of cost of food, pharmaceutical and biotechnological.

MS- 414 MARKETING MANAGEMENT & INTERANTIONAL TRADE (2+0)Sem.VII

THEORY

UNIT-I

Introduction: Conceptof Marketing, Functionsof Marketing, Concept of Marketing Management, Scope of Marketing, management, Marketing Management Process.

Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment-micro & macro environment, Consumer buying behaviour, Consumerism.

UNIT-II

Marketing Opportunities Analysis: Marketing research and Marketing Information Systems, Market measurement present and product development processes, Product brand, packaging service decisions.

Marketing Planning Process:

Product Policy Planning: Product mix, product line, product life cycle, New product development process, Product brand, Packaging, Service decisions.

Marketing Channel Decisions: Retailing, Wholesaling and Distribution.

UNIT-III

Pricing Decision: Price determination and pricing policy of biotechnological, food and pharmaceutical products in organized and unorganized sectors.

Promotion Mix Decision: Advertising: How Advertising works, Deciding, Advertising objectives, Budget, Message, Media Personal Selling, Publicity/ Public relation; Sales promotion.

Biotechnological, Pharmaceutical and Food product Marketing:

UNIT-IV

International Marketing and International Trade: Salient features of International Marketing; Composition & Direction of India exports and Imports. International Marketing Environment, deciding which & how to enter International Market.

Exports: Direct exports , Indirect exports, Licensing, joint ventures, Direct investments and Internationalization Process, Deciding Marketing Programme, Product promotion, Price, Distribution channels, Deciding the market organization, World Trade Organization (WTO).

MS-415 OPERATIONAL RESEARCH(2+1)Sem.VII

THEORY

UNIT-I

Introduction: Elementary concepts, Objectives of Operational research.

Application of OR in decision making

Modeling in Operational Research.

Linear Programming: Introduction, mathematical formulation of the problem. Graphical solution; Simplex technique for solving simple LP problems.

UNIT-II

Inventory Control: Introduction & General notion. Economic Lot Size, Models & discount criteria with known demand.

Replacement: Introduction & General notion. Replacement of items whose efficiency deteriorate with time and that fail completely; Individual and group replacement policy.

UNIT-III

Queuing: Introduction & General notions, Classification of Queues and their problems; Probability distribution of queues, various models in the queuing system.

Transportation model: Definition and application of transportation model. Formulation of transportation problems and their solutions.

Assignment model: Routing and traveling, Salesman problems, Transshipment model.

UNIT-IV

Framework of PERT and CPM: Activities, events and network. PERT and activity time estimate, Probability of project completion**,** Critical path analysis, PERT/ COST.Application of PERT and CPM in project management.

PRACTICALS:

1. Construction of OR models. 2. LP Problems. 3. Inventory Control Problems. 4. Replacement model problems. 5. Problem on queuing theory. 6. Problem on transportation. 7. Problem on assignment. 8. Problem on PERT/ CPM. 9. PERT/ COST problems.

IV Yr. II Semester B.Tech.(Bio Technology)

	In Plant Training	**5+20**