

I/IV B. Tech Biotechnology (1 Year)
M.P.C. Stream (Effective from the admitted Batch of 2007 -2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			theory		Pract .	Tot al	Univ.	Sessional	
			L	T					
1.	BTM 101	English	2		1	3	70	30	2
2.	BTM 102	Maths-I	3	-	-	3	70	30	4
3.	BTM 103	Maths-II	3		-	3	70	30	4
4.	BTM 104	Physics	3		-	3	70	30	4
5.	BTM 105	Chemistry	3	-	-	3	70	30	4
6.	BTM 106	History of Science & Technology	3	-	-	3	70	30	2
7.	BTM 107	CPNM [#]	3	-		3	70	30	4
8.	BTM 108	Engg. Graphics	2	-	4	6	70	30	5
9	BTM 109	Physics Lab	0	-	3	3	50	50	2
10.	BTM 110	Chemistry Lab	0	-	3	3	50	50	2
11.	BTM 111	Workshop Pract.	0		3	3	50	50	2
12.	BTM 112	Programming Lab	0		3	3	50	50	2
Total:			22		17	39	760	440	37

CPNM: Computer programming and numerical methods

II/IV B.Tech Biotechnology (1st semester)
M.P.C. Stream (Effective from the admitted Batch of 2007 -2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract.	Total	Univ.	Sessional	
			L	T					
1.	BTM 211	Mathematics – III	3	1	-	4	70	30	4
2.	BTM 212	Fundamentals of Biology	5	-	-	5	70	30	4
3.	BTM 213	Inorganic & Physical Chemistry	3	1	-	4	70	30	4
4.	BTM 214	Organic Chemistry	4	-	-	4	70	30	4
5.	BTM 215	Microbiology	4	-	-	4	70	30	4
6.	BTM 216	Basic Electrical & Electronics Engg.	3	1	-	4	70	30	4
7.	BTM 217	Chemistry Lab- II (Organic Chem.)	-	-	3	3	50	50	2
8.	BTM 218	Micro Biology Lab	-	-	3	3	50	50	2
Total:			22	3	6	31	520	280	28

II/IV B.Tech Biotechnology (2nd semester)
M.P.C.Stream (Effective from the admitted Batch of 2007-2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract.	Total	Univ.	Sessional	
			L	T					
1.	BTM 221	Bio Chemistry	3	1	-	4	70	30	4
2.	BTM 222	Genetics	3	1	-	4	70	30	4
3.	BTM 223	Chemical Process Calculations	3	1	-	4	70	30	4
4.	BTM 224	Thermodynamics	3	1	-	4	70	30	4
5.	BTM 225	Fluid particle technology	4	1	-	5	70	30	4
6.	BTM 226	Environmental Studies	3	-	-	3	70	30	3
7.	BTM 227	Bio Chemistry Lab	-	-	3	3	50	50	2
8.	BTM 228	Fluid particle technology Lab	-	-	3	3	50	50	2
Total:			19	5	6	30	520	280	27

III/IV B.Tech Biotechnology (1st semester)
M.P.C.Stream(Effective from the admitted Batch of 2007 – 2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract	Total	Univ.	Sessional	
			L	T					
1.	BTM 311	Biostatistics	3	1	-	4	70	30	4
2.	BTM 312	Immunology	4	-	-	4	70	30	4
3.	BTM 313	Genetic Engg.	4	-	-	4	70	30	4
4.	BTM 314	Heat Transfer	3	1	-	4	70	30	4
5.	BTM 315	Mass Transfer	3	1	-	4	70	30	4
6.	BTM 316	Cell & Molecular Biology	4	-	-	4	70	30	4
7.	BTM 317	Heat & Mass Transfer Lab	-	-	3	3	50	50	2
8.	BTM 318	Cell & Molecular Biology Lab	-	-	3	3	50	50	2
9.	BTM 319	Soft Skills	-	-	3	3	-	50	1
Total:			21	3	9	33	520	330	29

III/IV B.Tech Biotechnology (2nd semester)
M.P.C.Stream(Effective from the admitted Batch of 2007 -2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract	Total	Univ.	Sessional	
			L	T					
1.	BTM 321	Bio Anal. Technics	3	1	-	4	70	30	4
2.	BTM 322	Chemical Reaction Engineering	3	1	-	4	70	30	4
3.	BTM 323	Bioprocess Engineering	3	1	-	4	70	30	4
4.	BTM 324	Industrial Biotech Products	4	-	-	4	70	30	4
5.	BTM 325	Env. Biotechnology	3	1	-	4	70	30	4
6.	BTM 326	Pharmaceutical Biotechnology	3	1	-	4	70	30	4
7.	BTM 327	Chemical Reaction Engineering Lab	-	-	3	3	50	50	2
8.	BTM 328	Bio Anal. Tech. Lab	-	-	3	3	50	50	2
Total:			19	5	6	30	520	280	28

****Summer Industrial Training is Compulsory at the end of III year second semester and assessment will be done at the end of IV year first semester**

IV/IV B.Tech Biotechnology (1st semester)
M.P.C.Stream(Effective from the admitted Batch of 2007-2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			theory		Pract.	Total	Univ.	Sessional	
			L	T					
1.	BTM 411	Enzyme Technology	4	-	-	4	70	30	4
2.	BTM 412	Bio Informatics	3	1	-	4	70	30	4
3.	BTM 413	Bioprocess Design	3	1	-	4	70	30	4
4.	BTM 414	Instrumentation & Process Control	3	1	-	4	70	30	4
5.	BTM 415	Down Stream Processing	3	1	-	4	70	30	4
6.	BTM 416	Elective – I	3	1	-	4	70	30	4
7.	BTM 417	Bioprocess Design Lab	-	-	3	3	50	50	2
8.	BTM 418	Process Instrumentation & Control Lab	-	-	3	3	50	50	2
9	BTM 419	Seminar	-	-	3	3	-	100	3
10.	BTM 420	Industrial Training Report	-	-	-	-	-	100	2
Total:			19	5	9	33	520	480	33

IV/IV B.Tech Biotechnology (2nd semester)
M.P.C.Stream(Effective from the admitted Batch of 2007 –2008)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract	Total	Univ.	Sessional	
			L	T					
1.	BTM 421	Engineering Economics & Ind. Management	3	1	-	4	70	30	4
2.	BTM 422	Plant Cell & Tissue Culture	4	-	-	4	70	30	4
3.	BTM 423	Elective – II	4	-	-	4	70	30	4
4.	BTM 424	Plant Cell & Tissue Culture Lab	-	-	3	3	50	50	2
5.	BTM 425	Project Work	-	-	6	6	50	50	8
Total:			11	1	9	21	310	190	22

Elective – I: i) Basic biomedical Engineering

ii) Metabolic Engineering

Elective – II: i) Good manufacturing Practices

ii) Intellectual Property Rights and Commercialization of Biotechnology

(For the batch admitted in 2007-08)

BTM 211

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MATHEMATICS – III

Vector Calculus : Scalar, Vector fields, Gradient, Divergence, Curl, directional derivative, identities, irrotational and solenoidal vector fields, line integral, surface integral and volume integral,

Complex Analysis: Differentiability, Cauchy-Riemann equations, analytic functions Cauchy Theorem, Cauchy integral formula, Taylor and Laurent expansions, (without proofs),

Fourier Transforms: Fourier integral, Sine and Cosine Integrals, Complex forms of Fourier Integral, Fourier Transforms Fourier and Cosine Transforms, Finite Fourier Sine and Cosine Transforms. Properties of F-Transforms, Convolution Theorem for F-Transforms,

Partial Differential Equations and Applications: Introduction, first and second order equations, methods of separation of variables, one-dimensional and two-dimensional heat flow equations, solution of Laplace equation,

Numerical Analysis: Solution of non-linear equations of one variable using false position, secant and Newton-Raphson methods, solution of linear algebraic equations using Jacobi, Gauss-Seidel iterative methods, eigen values, eigen vectors using power method, integration using trapezoidal, Simpson's and other quadrature formulae.

Numerical Solutions of ODE's: Numerical solutions of ODE's by Picard's method, Euler's method, Runge-Kutta method

Textbook : Scope as given in:

1. Higher Engineering Mathematics (34 edition., 1998) by B.S.Grewal

Reference:

1. Higher Engineering Mathematics by M.K.Venkata Raman
2. Numerical methods for Scientific and Engineering Computation by M.K.Jain,
S.R.K. Iyengar, R.K.Jain publishers New Age International (p) Ltd, New Delhi.
3. Numerical methods for Engineers by Santosh K.Gupta, Pub. New Age New Delhi.
4. Numerical Analysis by G.Shankar Rao, Publishers New Age International New Delhi

FUNDAMENTALS OF BIOLOGY**Cell Biology**

Structure and function of prokaryotic and eukaryotic cell. Cell organelles – cell membrane, Chloroplast, Mitochondria, Golgi complex, Endoplasmic reticulum, Lysosomes, Ribosomes and Nucleus. Chromosome structure Mitosis and Meiosis.

Plant Biology

Parts of Flowering plant; Flower-structure of a typical flower, outline description of floral parts – Androecium, Gynoecium

Embryology

Structure of anther, microsporogenesis and development of male gametophyte. Structure of ovule, megasporogenesis, development of embryo sac. Fertilization and process of fertilization, Post fertilization changes.

Anatomy

Structure and function of xylem and phloem. Internal structure of Dicot root, stem and leaf. Monocot root, stem and leaf. Secondary growth of dicot stem.

Plant Physiology

Water relations of plants : Absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption.

Mineral nutrition: Criteria for essentially, macroelements (Nitrogen, Phosphorus and Potassium) and microelements.

Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, Photosystem I and II, photolysis of water, photophosphorylation, CO₂ fixation – C₃, C₄ and CAM pathway, Photorespiration, Factors affecting photosynthesis – Blackmann's Law of limiting factors.

Nitrogen metabolism: Introduction, nitrogen cycle, biological nitrogen fixation.

Plant Growth Regulators: auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene.

Plant Breeding:

Method of plant Breeding-selection, hybridization, hybrid vigor and mutational breeding.

Animal Biology

General Characters of Invertebrate: Morphology, Life cycle and reproduction of, *Plasmodium Vivax*, General Characters of Vertebrates.

Animal Physiology

Animal nutrition: Modes of nutrition, digestive system of Humans and accessory digestive organs, gastrointestinal secretions. Digestion, absorption and assimilation of digested products, excretion.

Respiration:

Respiration in humans – Respiratory system, mechanism of respiration.

Circulatory system: Blood vascular system in humans – Blood and its components, heart, pumping action of hearts, heart beat and pulse, important blood vessels and course of blood circulation, Lymphatic system-lymph, lymph vessel, lymph nodes and lymphatic ducts and pacemakers.

Excretion:

Elimination of nitrogenous waste- Ammonotelic, ureotelic and uricotelic. Structure of human excretory system- structure of urinary system, anatomy of kidney and structure of nephron.

Nervous system:

Structure of neuron, nerve impulse and its conduction, synapse, central nervous system-lobes of brain and its meninges, spinal cord. Peripheral nervous system- Cranial nerves and spinal nerves. Autonomic nervous system- sympathetic and parasympathetic nervous system, reflex action – reflex arc of humans.

TEXT BOOKS

- 1) Biology text book for class XI and XII, NCERT.
- 2) AP academy textbook for botany and zoology at intermediate

INORGANIC & PHYSICAL CHEMISTRY**Atomic Structure and Periodicity**

Schrodinger wave equation-quantum mechanical model of hydrogen atom..

Structure and Bonding

Ionic bond-Ion-pair molecules. Covalent bond-Lewis theory-valence bond theory-hybridization-VSEPR theory and shape of molecules- molecular orbital treatment for H₂, He₂, N₂, O₂, O₂⁻, O₂²⁻, F₂, NO and CO.

Coordination Compounds

Werner's theory- effective atomic number- bonding in transition complexes-valence bond and crystal field theory-octahedral, tetrahedral and square planar complexes.

Representative elements

General Properties and oxidation states of s and p block elements. Ammonia, nitrites & Nitrates Phosphates, Phosphites & Phosphorothianes. Organo silanes, silicones & silicates. Fluorocarbons – effect of UV radiation.

Transition Elements

Oxidation states – colour – magnetic properties – complexes – comparison of the elements of second and third transition series with the first transition series.

Solid, Liquid and Gaseous state

Amorphous and crystalline solids – classification of solids according to bond type – ionic, covalent, metallic, molecular solids – crystal systems – space lattice and unit cell – crystal defects.- Vapour pressure of Liquids – Clapeyron-Clausius equation – surface tension and viscosity. Gas Laws – ideal gas equation – Dalton's law of partial pressure – Graham's law of diffusion – kinetic theory of gases – molecular velocities – deviation from gas laws – van der Waal's equation – critical constants.

Electrochemistry

electrochemical series-half-cell potential-EMF-Nernst equation-Galvanic cells.

Colligative properties

Raoult's law, Osmotic pressure, elevation of boiling points, depression in freezing points (no thermodynamic derivations)-elementary treatment of vapour pressure-composition diagrams of binary liquid mixtures.

Phase Rule

Terms used – phase diagrams-one component system (Water and Sulphur) – two-component system (Silver-Lead and Potassium Iodide-Water)-Eutectic point and Triple point.

Prescribed books:**Inorganic Chemistry:**

1. Concise Inorganic Chemistry, 5th edition- J. D. Lee., Blackwell Science Ltd., London.
2. University General Chemistry, by C. N. R. Rao., Macmillan India Pub. Co.,

Physical Chemistry:

1. Physical chemistry by P. W. Atkins, third edition, Oxford University press.
1. Essentials of Physical Chemistry, Revised edition 2005-B.S.Bahl, Arun Bahl and G.D.Tuli, S. Chand & Company Ltd., India.

ORGANIC CHEMISTRY

Unit : 1 Fundamentals and Stereo Isomerism: Fundamental analysis – Molecular weight, empirical and molecular formula determination. Basics of optical and geometrical Isomerism – Sequence rules, R and S configurations, E, Z notation. Stereo isomerism of aliphatic hydrocarbons (cyclohexane and its derivatives only)

Unit : 2 Aliphatic compounds: Alkanes: Preparation by Wurtz reaction, Kolbe electrolytic method. Free radical substitution (Mechanism of halogenation). Energy of activation and transition state. Alkenes: Industrial preparation of ethylene 1,2 elimination reaction (E1 and E2 mechanism), electrophilic and Free radical addition reactions (Markovnikov's and AntiMarkovnikov's rule).

Isoprene rule, Rubber, Vulcanisation.

Alkynes: Industrial method of acetylene, acidity of alkynes, Dienes-1,2 and 1,4 addition, diels-Alder reaction.

Cyclo alkanes : Preparation and properties of simple cycloalkanes, Bayer's strain theory.

Alkyl halides: SN1 SN2 reactions with mechanisms.

Unit:3 Aromatic compounds: Benzene: Structure of benzene, Aromatic character, Electrophilic aromatic substitution (Mechanism of Nitration, Sulphonation, Halogenation, Friedel crafts alkylation and acylation). Orientation of disubstituted benzenes-activating and deactivating groups.

Arenes: Preparation of arenes, Clemmensen and WolffKishner reductions.

Arylhalides: Preparation of arylhalides by Sandmeyer and Gattermann reaction. Nucleophilic aromatic substitution.

Unit : 4 Alcohols and Carbonyl compounds: Alcohols: Industrial method of preparation of Ethyl alcohol-Differentiation tests for primary, secondary and tertiary alcohols, Grignard synthesis of alcohols.

Ethers: Preparation of ethers and epoxides-Williamson synthesis.

Aldehydes and Ketones: Nucleophilic addition reactions, carbanion reaction, Cannizzaro reaction, Aldol condensation, Perkin, Reformatsky and Wittig reactions.

Unit:5 Amines and Carboxylic acids: Amines: Industrial method of preparation of aniline and aliphatic amine-Reductive amination – Hoffmann elimination, Benzidine rearrangement, effect of substituents on basicity, Distinguishing tests, Diazonium salts and applications.

Sulpha Drugs: Preparation of sulphanilamide

Carboxylic acids: Preparation and properties of carboxylic acid (acetic acid, Benzoic acid), effect of substituents on acidity, HVZ reaction.

Dicarboxylic acids: Preparation and properties of Oxalic, Succinic and Adipic acids.

Functional derivatives of carboxylic acids: Hoffmannbromamide reaction, Claisen condensation.

Preparation and properties of Malonic ester and acetoacetic ester, Keto-enol Tautomerism.

Unit : 6: Carbohydrates: Classification, stereochemistry, Reactions of Glucose and Fructose and their inter conversions – Killiani-Fischer synthesis, Ruff degradation and Wohl's degradation.

Text Book: 1. Text book of organic chemistry by R. T. Morrison and R. N. Boyd.

Reference books;

1. A Text book of organic chemistry by I. L. Finar (Vol. I) Longman group
2. A Text book of organic chemistry by L.G.Wade, Jr. Pearson education
3. A Text book of organic chemistry by Francis A . Carey. Tata Mc Graw-Hill

MICROBIOLOGY

History and Development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck. Further developments of Microbiology.

Microbial Taxonomy and Physiology: Bacteria, Archea and their broad classification. Molecular approaches to Microbial taxonomy. Physiology of Extremophiles.

Morphology and Functions of Viruses, Yeast, Molds and Bacteria :

Viruses- Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle.

Yeast and Molds: Morphology, Life cycle, economic importance of Yeast and *Aspergillus*

Bacteria : Ultra structure of Bacteria, Cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell.

Microbial growth : Definition of growth- growth curve. Measurement of bacterial growth (cell number and cell mass) growth yield, continuous culture- chemostat, turbidostat, synchronous growth, effect of environmental factors on growth.

Control of Microorganisms : Sterilisation, and disinfection, effect of physical(moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance.

Microbial Nutrition : Nutrition requirements, Nutritional types of bacteria up-take of nutrients by cell.

Methods in Microbiology : Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, Light(bright field only) and electron microscopy.

Applied Microbiology : Water , Food and Milk born contamination and remedy; Basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important Micro-organisms.

Text Books:

1. Microbiology :Prescott L.M.,Hrley J.P.,Klein D.A., McGraw- Hill

Reference books:

1. Microbiology :Pelzar, M.J., Chan, E.C.S.,Kreig,N.R., Tata McGraw-Hill
2. Brock biology of Microorganisms, Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall'

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(**Five** questions to be set from **Section A** and **Three** questions from **Section B**)
Section-A

Fundamentals Laws and Theorems: KVL, KCL, Ohm's law, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem.

D.C. and A.C. Circuits: Mesh analysis, Nodal analysis, Star-Delta transformation, Sinusoidal steady state analysis of 1- ϕ circuits, series and parallel circuits, 3- ϕ circuits, Star-Delta circuits.

D.C. Machines : Construction and working of D.C. Generators, EMF equation, classification, characteristics, armature reaction, construction and working of D.C. Motors, torque equation, characteristics, speed control methods and 3-point starter, efficiency calculation.

Single phase Transformers: Construction and working of single phase transformers, equivalent circuits, efficiency, regulation, O.C and S.C tests.

A.C. Machines: Construction and working of 3 - ϕ Induction motor, slip, torque equation, efficiency, calculation, construction and working of Synchronous Generator (Alternator), EMF equation, regulation-synchronous impedance method, Synchronous Motor, torque equation, starting methods.

Section-B

Electronics: Characteristics of Semiconductor Diodes, Transistors, characteristics of CB, CE, CC transistor configurations, Oscillators, Cathode Ray Oscilloscope, construction, working, applications, Mechanical Transducers, Electrical Transducers, Pressure Gauges, LVDT.

Text Books :

- 1.V.K. Mehta: Elements of Electrical Engineering and Electronics.,S.Chand & Co.
2. B.L.Thereja: Fundamentals of Electrical Engineering and Electronics.
- 3.Allen Mottorshad: Electronic Devices and Circuits., Prentice Hall of India.
4. V.N. Mitthal: Basic Electrical Engineering., Tata Mc-Graw Hill

CHEMISTRY LABORATORY – II
(ORGANIC CHEMISTRY)

1. Preparation of simple organic compounds involving the following reactions:

- a) Acetylation : Acetanilide from Aniline and Aspirin from Salicylic acid
- b) Benzoylation: Benzanilide from Aniline
- c) Nitration: p-nitroacetanilide from acetanilide
- d) Methylation: β -naphthyl methyl ether from β -naphthol
- e) Sulphonation: Sulphanilic acid from Aniline
- f) Oxidation: p-benzoquinone from Hydroquinone

2. Qualitative analysis: Identification of the following functional groups in at least

SIX organic compounds by adopting a systematic qualitative procedure:

- a) Carboxylic acids
- b) Phenols
- c) Aldehydes and Ketones
- d) Esters
- e) Carbohydrates
- f) Hydrocarbons and Ethers
- g) Primary, Secondary and Tertiary amines
- h) Amides and Imides
- i) Nitro groups

Text Book:

A Text book of Qualitative Organic Analysis by A.I. Vogel (Orient Longmans Ltd.,)

Microbiology Laboratory

List of Experiments :

1. Preparation of Nutrient broth and inoculation of Bacteria.
2. Preparation of Nutrient agar and inoculation of Bacteria
3. Isolation of pure cultures
4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.
5. Motility of Microbes.
6. Morphology of Fungi-(*Aspergillus niger*)
7. Morphology of Yeast-(*Saccharomyces cerevisiae*)
8. Bio-chemical tests- IMViC test, Amylase test, Hydrogen Sulphide production test
9. Testing of Microbiological quality of milk.
10. Testing of Microbiological quality of water.
11. Microbial assay of antibiotics.
12. Evaluation of disinfectant.

Text Books :

Microbiology- a Laboratory Manual, Cappuccino T.G., Sherman N-Addison Wesley.

BIOCHEMISTRY

Scope and importance of Biochemistry.

Carbohydrates: Classification, chemistry and properties of monosaccharides (Ribose, Glucose, Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolysaccharides). Metabolism of carbohydrates : Glycolysis, TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, Glycogenesis and Glycogenolysis.

Proteins and amino acids: Classification and properties of aminoacids and proteins, peptide bond, chemical synthesis of peptides and Solid-phase peptide synthesis. Structural organization of proteins: primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins.

Lipids: Classification, structure and physiological functions of triglycerides, fattyacids, phospholipids, cerebrosides, gangliosides and cholestrol. Digestion and absorption of fats, biosynthesis and degradation of fattyacids and triglycerides.

Nucleic acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids. Types of nucleicacids, double helical structure of DNA, types of RNA. Biosynthesis and catabolism of purines and pyramidines.

Enzymes: Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes. Enzyme inhibition- competitive, non-competitive and uncompetitive inhibitions.

Porphyryns: Chemistry of haemoglobin and chlorophyll; syntheis of heme and chlorophyll andheme catabolism.

Vitamins and harmones: definition, classification, chemistry, source, functions and deficiency of vitamins. Out lines of harmones and their functions.

Text Books:

1. Fundamentals of Biochemistry – J.L.Jain, S.Chand & company Ltd, New Delhi.
2. Principles of Biochemistry- Lehninger, Nelson and Cox
CBS Publications.

GENETICS

Mendel's law of Inheritance : Gregor Mendel's life, pre-Mendelian experiments, Mendel's experiments–Mendel's materials, crossing technique, results of Mendel's experiments; Phenomenon of Dominance, Variation in dominance relation–incomplete dominance, Co-dominance; Principle of segregation–monohybrid cross, mechanism of segregation, monohybrid ratio; Principle of independent assortment–Mendel's dihybrid cross, mechanism of independent assortment, Dihybrid ratio; Back cross and test cross; Deviations from dihybrid phenotypic ratio; Trihybrids and polyhybrids.

Interaction of Genes : Interaction of genes–combs in fowls, Epistasis, complementary genes, duplicate genes; Additional interactions involving two gene pairs; Interaction between more than two gene pairs.

Quantitative / Multiple factor inheritance : Multiple factors; Quantitative and quantitative traits; Examples of quantitative inheritance–Kernel color in wheat, skin color in man, corolla length in tobacco; Continuous variations.

Multiple alleles : (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles; skin color in rodents, eye color in *Drosophila*, self sterility in *Nicotiana*, blood groups in humans; complementation test or cis-trans test.

Linkage, crossing over and mapping :

Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage–complete linkage, incomplete linkage, linkage groups, significance of linkage.

Crossing over – Types of crossing over–somatic (or) mitotic crossing over, germinal (or) meiotic crossing over, mechanism of meiotic crossing over–synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization. Molecular mechanism of Recombination–Holiday model cytological basis of crossing over; significance of crossing over.

Construction of a genetic mapping : Two point and three point test crosses and gene mapping, interference and coincidence.

Sex Determination : Genetically controlled sex determining mechanisms – Sex chromosomal mechanism of sex determination; Types–heterogenetic males, heterogenetic females; Genic balance mechanism (X/A ratio in *Drosophila*), Sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; Haploid males in hymenoptera; Hormonal control of sex; environmental control of sex; Dosage compensation (in man and *Drosophila*).

Sex Linkage : Inheritance of sex linked (X-linked) traits–eye color in *Drosophila*, Haemophilia and Color blindness in human and barred plumage in poultry; Inheritance of Y-linked genes; Inheritance of XY-linked genes; Primary and secondary non-disjunction of sex chromosomes, sex influenced (horned character in sheep) and sex limited traits (cock feathering in poultry and baldness in man), sex linked disorders in human beings.

Cytoplasmic Inheritance : Maternal effects–shell coiling in snails, pigment in flour moth; Cytoplasmic inheritance involving dispensable heredity units–Kappa particles in *Paramecium*; CO₂ sensitivity in *Drosophila*; Cytoplasmic inheritance by cellular organelles–Plastid inheritance in variegated four-o'clock plant, Iojop inheritance in corn, Mitochondrial inheritance–male sterility in plants, Petite in Yeast, Poky in Neurospora; uniparental inheritance in *Chlamydomonas*.

Chromosomal variations : Origin, types and cytogenetic effects

Structural changes in chromosomes : Duplications, Translocations, Inversions (paracentric and pericentric cross over suppressors)

Numerical changes in chromosomes : Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy); Euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

Population genetics : gene frequencies in population :

Gene pool and gene frequencies; equilibrium of gene frequencies and Hardy-Weinberg law-application of Hardy-Weinberg law in calculating gene frequencies in a population (two alleles and more than two alleles) changes in gene frequencies (mutation, selection and migration; random drift)

Text Books :

1. Genetics : Gupta P.K.; Rastogi Publications.
2. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology : P.S. Verma & V.K. Agerwar – S. Chand & Company

Reference Books :

1. Principles of Genetics: E.J. Gardner, M.J. Simmons & D. Peter Snustard; John Wiley & Sons, INC.

CHEMICAL PROCESS CALCULATIONS

Stoichiometry and composition relationships : The gram-mole and pound-mole – Limiting reactant – Excess reactant – Degree of completion – Basis of Calculation – Weight percent, Volume percent and mole percent – Density and Specific Gravity.

Behavior of Ideal gases : Application of the Ideal-gas law – Dalton and Amagat laws to gaseous mixtures – Composition of gases on dry basis and on wet basis.

Vapour pressure : Vaporisation – Condensation – Vapour pressure – Effect of temperature on vapor pressure – Antoine equation – Reference substance vapor pressure plots – Vapour pressure of immiscible liquids – Ideal solutions and Raoult's law – Non-volatile solutes.

Humidity : Molal Humidity – Percentage Saturation – Relative saturation or Relative Humidity – Dew point – Dry-bulb temperature – Wet-bulb temperature

Material Balance : Tie substance – Yield – Conversion – Processes involving chemical reactions – Material balance calculations involving drying – Dissolutions and Crystallization – Processes involving Recycle, Bypass and Purge.

Heat Capacities of gases and gaseous mixtures : Effect of temperature on heat capacity of gas – Mean heat capacity of gases – Latent heats – Heat of fusion – Heat of vaporization – Estimation of latent heat of vaporization using Clausius – Clapeyron equation – Enthalpy of humid air and humid heat capacity.

Standard heat of reaction – Standard heat of formation – Laws of thermo chemistry – Standard heat of combustion – Calculation of heat of formation from heats of combustion – Calculation of Standard heat of reaction from heats of formation and from heats of combustion – Effect of temperature on heat of reaction – Adiabatic and non-adiabatic reactions.

Text Books :

1. Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kwenneth M. Watson, and Roland A Ragatz, CBS Publishers and Distributors (1995).

Reference Books:

1. Stoichiometry(SI Units) by B.I.Bhatt and S.M.Vora Tata McGraw Hill Publishing Compy Ltd.,
2. Basic principles and calculations in chemical engineering by David M.Himmelblau, Prentice Hall of India Pvt.Ltd. (1995).
3. Stoichiometry and process Calculations, by K.V.Narayanan and B.Lakshmikutty. Prentice Hall of India Pvt.Ltd. New Delhi. (2006).

THERMODYNAMICS

The first law and other basic concepts : Joule's Experiments – Internal Energy – The first law of Thermodynamics – Thermodynamics state and state functions – Enthalpy – the steady state – Steady – Flow Process – Equilibrium – The Phase Rule – The Reversible Process – Constant 'V' and Constant 'P' processes – Heat capacity.

The second law of Thermodynamics: Statement of the second law – Heat engines – Thermodynamic temperature scales – Thermodynamic temperature and ideal – Gas scale.

Entropy : Entropy changes of an ideal gas – Mathematical statement of the second law – The third law of thermodynamics – Entropy from the microscopic view point.

Chemical Reaction Equilibria : The reaction coordinate – Application of equilibrium criteria to chemical reactions – The standard Gibbs energy change and the equilibrium constant – Effect of temperature on the equilibrium constant – Evaluation of equilibrium constants – Relation of equilibrium constants to composition – Equilibrium conversions for single reactions – Phase Rule and Duhem's Theorem for reacting systems – Multi-reaction equilibria.

Biochemical Thermodynamics :

Energetics of metabolic pathways – Energy coupling (ATP & NADH) – Stoichiometry and energetic analysis of cell growth and product formation – Elemental balances – Degree of reduction concepts – Oxygen consumption and heat evolution in aerobic cultures – Thermodynamics efficiency of growth.

Text Books :

1. "Introduction to Chemical Engineering Thermodynamics". J.M. Smith, H.C. Vanness & M.M. Abbott, 6th Ed. McGraw Hill Book Co., New York, 2001.
2. "Kinetics and Energetics & Biotechnology", J.A. Roels, Elsevier, 1983.

FLUID PARTICLE TECHNOLOGY

Dimensional analysis – Types of fluids – Hydrostatic Pressure – Pressure distribution in static fluids – Pressure measuring devices

Introduction to fluids in motion : Concept of stream lines, stream tubes – Viscosity – Types of fluids – Flow in boundary layers its formation and growth in tubes and a plates – Basic equations of fluid flow : Continuity – Momentum - Bernoulli's equation and Navier – Stoke's equation.

Flow of incompressible fluids in pipes – Relation between skin friction and wall shear – Laminar flow in pipes – Hagen-Poiseuille equation – Turbulent flow in pipes – Velocity distribution equation – Friction factor – Friction from changes in velocity or direction – Flow of compressible fluids, basic equations, flow through variable area conduits.

Flow past immersed bodies – Flow through beds of solids – Motion of particles through fluids – Fluidization: Mechanism of fluidization applications of fluidization

Transportation and metering of fluids: Pumps, fans, blowers and compressors – reciprocating, rotary and centrifugal pumps – flow measuring devices : venturi meter, Orifice meter, Pitot tube, rotameter, notches and weirs.

Characteristics of solid particles : Shape – Size Differential and cumulative screen analysis – Specific surface Area – Particle population – Different mean diameters for a mixture of particles – Storage of solids.

Principles of comminution – Laws of crushing (Rittinger's, Bond's, Kick's laws) – Work Index – Classification, description and working of size reduction equipment – Jaw, Gyratory and Roll crushers – Hammers – Revolving mills – Attrition mills – Fluid energy mill – Cutting machines – Open and Closed circuit grinding – wet and Dry grinding – Grindability Index.

Size separation: Screening – Industrial screens – Grizzly – Gyratory and vibratory screens – Revolving screens – Trommels – Capacity and effectiveness of screens – Froth flotation.

Text Books :

1. "Unit Operations of Chemical Engineering" , Warren L. Mc Cabe and Julian C. Smith 6th Edition.

Reference books;

1. "Transport processes and Unit Operations", Christie J. Geankoplis; Prantice-Hall of India (pvt) Ltd., New Delhi.

BTM 226

L: 3 T: 0

ENVIRONMENTAL SCIENCES

(Common for all branches)

BTM 227

P: 3

BIOCHEMISTRY LABORATORY

1. Estimation of total Carbohydrates
2. Estimation of Glucose.
3. Estimation of Proteins.
4. Estimation of Amino acids
5. Estimation of Lipids and of Cholesterol.
6. Assay of Enzymes-Protease, Phosphatase, Urease, Catalyse and Amylase.
7. Determination of K_m value.
8. Estimation of Nucleic acids.
9. Determination of T_m of DNA.
10. Estimation of DNA by Di-phenyl amine reagent method,
11. Estimation of RNA by Orcinol method.
12. Extraction of Caffeine from tea leaves

Text Books :

1. Biochemical methods 2nd Edition Sadasivam and Manickam, New Age.
2. Introduction to Practical Biochemistry, Plummer, Tata Mc Graw Hill.
3. Practical Biochemistry, Sawhney.
4. Laboratory manual in Biochemistry- J.Jayaraman, New Age International Publications

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FLUID PARTICLE TECHNOLOGY LAB

List of Experiments: Any 12 of the following

1. Identification of Laminar and Turbulent flows (Reynolds Apparatus)
2. Measurement of Point Velocities (Pitot Tube)
3. Verification of Bernoullis Equation
4. Calibration of Rotameter
5. Variation of Orifice Coefficient with Reynolds Number
6. Determination of Venturi Coefficient
7. Friction losses in fluid flow in pipes
8. Pressure drop in a packed bed for different fluid velocities
9. Studying the coefficient of discharge in a ' V ' notch.
10. Studying the coefficient of contraction for a given open orifice.
11. Study of the characteristics of a centrifugal pump
12. Sampling of Materials (Riffle sampling & Cone quartering sampling)
13. Size separation: Froth Flotation
14. Determination of Energy consumption in size reduction [Crushability test (Roll or Jaw crusher),
15. Determination of Energy consumption and grindability index for Hard grove machne
16. Determination of Energy consumption and grindability index for Ball Mill

Introduction, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples

Moments, skewness and kurtosis, correlation, scatter diagram, coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation

Probability distribution and sampling theory: Random variable both discrete and continuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution, **Sampling Theory**: sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f-distribution, Fisher's z-distribution, Chi-square distribution

Numerical solutions of PDEs – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method)

TEXT BOOKS:

1. Higher engineering mathematics by B.S.Grewal

REFERENCES:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi
2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.
3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

Unit 1: Introduction to Immunology and its origin in vertebrates and invertebrates. Immunity-Innate immunity and acquired immunity and the various lines of defence. Organs of immune system- Thymus, Bone marrow, Bursa of Fabricius, Spleen, Lymphnode and MALT. Cells of immune system- B-cells, T-cells, Antigen presenting cells, Monocytes, NK cells and langerhan cells.

Unit 2: Antigens- Properties of antigens, Haptens, epitopes, T-dependent and T-independent antigens. Adjuvants and their clinical importance. Immunoglobulins- Classification, structure and functions of immunoglobulins. Antigenic determinants on antibodies. Antigen – antibody reactions, and tests involving them- Precipitation tests, agglutination tests, complement fixation tests, Immunofluorescence, RIA, ELISA, Western blotting and ELISPOT.

Unit 3: Complement system- its components, complement fixation pathways and consequences. MHC- In mice and human, structure of MHC molecules and their role in antigen presentation. Immune response- Humoral and cell mediated immuner espns, IR curve. Role of cytokines in immunity, Interferons and interleukins. Immune suppression. Immune tolerance.

Unit4: Hypersensitive reactions- Type I, II, III and IV reactions, and their role in graft rejection. Transplantation immunology- classification of grafts and immunology of graft rejection. Agents used for preventing graft rejection. Autoimmune diseases- definition and few examples.

Unit 5: Hybridoma technology- Production of monoclonal antibodies and their applications. Vaccines and vaccination- Methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

Reference book:

1. Immunology – Ivan Roit.
2. Immunology- A.Godsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby.

Text books:

1. A text book of microbiology- R.Ananthanarayan and C.K.J.Pandey.
2. Immunology- Saras Publications.

UNIT – I: History and scope of gene manipulation, isolation separation and purification of nucleic acids, enzymology and DNA manipulation – definition and mechanism of restriction endonucleases, ligases and recombinases.

UNIT – II: Cloning vectors – construction and application of plasmids, cosmids, phasmids, plasmid yeast and YACs, Transfer and cloning of recombinant vectors, gene cloning strategies. Construction of genomic DNA libraries and cDNA libraries and their screening.

UNIT – III: Preparation of labeled probes and primers, DNA sequencing methods, PCR and its applications – Southern Blotting, northern blotting, DNA finger printing technique, RFLP and RAPD.

UNIT – IV: Gene transfer techniques – transformation, transfection, electroporation, lipofection and gene gun methods. Site specific mutations, cause of the mutagenesis, transposon mutagenesis, gene knockout technologies.

UNIT – V: Application of genetic engineering in agriculture, animal husbandry, medicine, environmental management and in industry. Achievements, limitations and negative aspects of genetic engineering.

TEXT BOOKS:

2. Recombinant DNA. Watson et al., Scientific American Books.
3. Principles of gene manipulation. Old and Primrose. Blackwell
4. From genes to clones. Winnacker
5. Gene cloning and DNA analysis. Brown T.A. Blackwell Science
6. Genetic Engineering, Sandhya Mitra
7. Biotechnology – B.D.Singh

HEAT TRANSFER

-Introduction : Modes of heat transfer – Basic laws of heat transfer – Analogy between Heat flow and electrical flow.

Conduction : Fourier law of heat conduction – Steady state one dimensional heat conduction through plane wall, Cylinder wall and Composite structures – Three dimensional heat conduction equation Critical insulation. Conduction with heat generation.

Convection : The convective heat transfer coefficient – Introduction to thermal boundary Layer – Dimensionless numbers in heat transfer and their significance – Dimensional Analysis.

Forced Convection : Heat transfer by forced Convection inside tubes and ducts in Laminar, transition and turbulent flow – Analogy between momentum and heat transfer - Reynolds colburns and prandtl analogies – Heat transfer to tubes in cross flow Empirical relations in agitated vessels.

Heat transfer with phase change : Heat transfer from condensing vapors – Film wise and dropwise condensation – condensation of super heated vapors – effect of non Condensables gases on rate of condensation.

Heat transfer to boiling liquids : Boiling of saturated liquids – Maximum heat flux and Critical temperature drop – Minimum flux and film boiling.

Heat transfer by radiation : Thermal radiation – Black body radiation – Kirchhoff's law - Emissivity – Combined heat transfer by conduction convection and radiation.

Heat exchangers : Types of heat exchangers - Fouling Factors – Description of Heat transfer equipment : Heat exchangers , Condensers , Boilers and kettles – Extended surface equipment

Evaporation_: Types of evaporators – capacity and economy of evaporators – Boiling point elevation and Duhring's rule – material and energy balance in single effect Evaporator – Multiple effect evaporator- Methods of feeding.

Text Books :

1. Unit operations of Chemical operations 6th Ed. By W. L . Mc. Cabe . J.C.Smith and P.Harriot
2. Transport processes and unit operations by Christie j. Geankopolis prentice. Hall of India limited. New Delhi.

Reference Books:

1. Heat transfer by Holman J.P. ,Mc Graw Hill, Newyork 6th Ed 1997.
2. Heat transfer by Y.V.C Rao.

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L:3, T:1

MASS TRANSFER

Introduction: Mass Transfer Operations - Molecular Diffusion in Fluids, binary Solutions - Ficks Law - Equation of Continuity - Steady state Equimolar counter Diffusion - Multicomponent diffusion - Stefan Diffusion - Estimation of Diffusivity of gases and liquids - Application of molecular diffusion - Diffusion in Solids : Ficks law of diffusion in solids- Types of solid diffusion.

Mass transfer Coefficient & Interphase Mass transfer: Mass transfer coefficient Theories of Mass transfer - Analogy between Momentum, heat and Masstransfer Concept of equilibrium – Diffusion between phases – Relation between individual and Overall mass transfer coefficients – Material balaces in Steady state Co-current and Countercurrent stage processes.

Distillation : Principles of VLE for binary systems - Phase Diagrams – Relative volatility Flash Vaporization – Partial Condensation – Differential Distillation – Steam Distillation Continuous Distillation – Mc Cabe Thiele method for construction of theoretical stages Tray efficiencies – Azeotropic and Extractive Distillation.

Absorption : Solubilities of gases in liquids – Two component system – Ideal and Nonideal solutions – Choice of Solvent for absorption – Single component absorption Material balance – Counter current multistage operations – Dilute gas mixtures – HETP - HTU - NTU Concepts for Single component Absorption – Calculation of height of packed tower.

Humidification :_Definition of fundamental terms – Psychrometric Charts – Theory of Adiabatic Saturation and Wet bulb temperature – Lewis Relation – Gas liquid Contact operations – Water cooling with air – Dehumidification of Air and water Vapor mixture – Cooling towers.

Text Books :

1. Mass transfer operations by Robert E Treybal.
2. Unit operations of Chemical operations 6th Ed. By W. L . Mc. Cabe . J.C.Smith and P.Harriot.

Reference Books:

1. Chemical Engineering Vol 1 & Vol 11 by Coulson J.M. & Richardson J.F.
2. Unit operations of Chemical engineering Vol 1 by Chattopadhyay P

BTM 316

L:4, T:0

CELL AND MOLECULAR BIOLOGY

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genome organization in Eukaryotes- DNA Kinetics and cot curves, Nucleotide composition – Unique, Middle and highly repetitive DNA, Mitochondrial and plastid genomes.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression: Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

Regulation of gene expression in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

TEXT BOOKS:

1. "The world of the cell" Becker, Klein smith & Hordin, Pearson education

REFERNCE:

1. Molecular cell biology by Lodish et.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

BTM 317

P:3

HEAT AND MASS TRANSFER LABORATORY

MASS TRANSFER LABORATORY

- 1) Ternary Liquid Equilibria (Binodal Curve)
- 2) Liquid-Liquid Equilibria
- 3) Limiting flow rates in spray towers
- 4) Hydrodynamic studies in Sieve Plate Tower
- 5) Dynamics of Liquid Drops (single Drop Extraction Tower)
- 6) Volumetric mass transfer coefficients in perforated plate tower
- 7) Studies of Axial Mixing Characteristics in a Packed Bed
- 8) Vapor-liquid Equilibrium
- 9) Solid liquid Equilibria
- 10) Steam distillation
- 11) Gas liquid mass transfer in packed tower

HEAT TRANSFER LABORATORY

- 1) Determination of total thermal resistance and thermal conductivity of a composite wall apparatus
- 2) Study of the temperature distribution along the length of a pin fin under natural and forced convection conditions

- 3) Determination of thermal conductivity of metal rod
- 4) Determination of forced convective heat transfer coefficient for air flowing through a pipe
- 5) Determination of natural convective heat transfer coefficient for a vertical tube.
- 6) Determination of emissivity of a given plate at various temperatures.
- 7) Determination of overall heat transfer coefficient in a double pipe heat exchanger.

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CELL AND MOLECULAR BIOLOGY LAB

CELL BIOLOGY:

Study of Mitosis, Meiosis, Differential staining of euchromatin and heterochromatin, Florescent *in situ* hybridisation - FISH (Principle & Photographs).

MOLECULAR BIOLOGY:

Isolation of genomic DNA, quantification of DNA, Agarose gel electrophoresis, Isolation of plasmid DNA, Restriction digestion, ligation, Transformation, Southern blotting, Isolation and analysis of RNA.

Text Books:

- 1."A Guide to Molecular Cloning", Vol. 1,2 & 3 Sambrook, J. et al., Cold Spring Harbor Laboratory Publications
2. Chromosome techniques. Sharma & Sharma

BTM 319

SOFT SKILLS

Reading Skills, Notes taking, Information seeking methods, Report writing, Preparing Presentations, Task Planning, Organizing and Execution

Self Development, Interpersonal Skills, Problem Solving, decision Making, Conflict Resolution and Task Completion

Learning techniques, Study habits

Time matrix, meditation and Yoga, SWOT analysis, Goal setting, Interview techniques, leadership styles, conflict resolution strategies, group discussion

Communication methods, Presentation methods, selection of Aids

Time management, stress management, principles of body language, self motivation, Human psychology, leadership principles.

Text Books:

1. Jeanne. E.O Human learning Prentice Hall, New jersey
2. Kenneth a kiewra NelsonF. Dubois Learning to learn Allyn and Bacon

References:

1. E.H. Megrath Basic managerial skills for all Prentice hall of India Ltd.
2. P.D. Kulkarni &B.B.Sharama Independent study techniques T.T.T.I.Chandigarh
3. Trevor L. Young The handbook of project management Kogan page
4. Michael Davies Trainer's GuideProject management Kogan page
5. Elizabeth Hierney 101 ways to better communication Kogan Page

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L:3, T:1

BIOANALYTICAL TECHNIQUES

Unit 1: Chromatography- Distribution coefficient, modes of chromatography. Paper, Thin layer, Ion-Exchange and Affinity chromatography. GLC- Principle, sample preparation, apparatus, detectors types and applications. HPLC- Principle, Components and applications.

Unit 2: Electrophoresis- General principles, support media and applications. SDS-PAGE, Isoelectric focusing, Agarose gel electrophoresis, capillary electrophoresis. Centrifugation- Principle of sedimentation, sedimentation coefficient, Preparative and Analytical centrifuges, Ultracentrifuge. Differential centrifugation, density gradient centrifugation. Applications- in determination of molecular mass, purity and conformation of macromolecules.

Unit 3: Radioisotope techniques- Detection and measurement of radioactivity. Gas ionization, Excitation of solids and solutions, Autoradiography, Application in biological sciences-Metabolic pathways, turn over time determination, isotope dilution analysis, radiodating, clinical diagnosis and sterilization and tracer techniques. Biosensors- Principle and applications of Electrochemical, Thermometric, Optical and Piezoelectric Biosensors.

Unit 4: UV Visible Spectroscopy- Principle, Beer-Lamberts law, Instrumentation of Single and Double beam spectrophotometers. Bathochromic and hypsochromic shifts and applications. Turbidometry and Nephelometry- Principles and Applications. Infra red and Raman Spectroscopy- Principles and Applications. Spectrofluorimetry- Principle and Applications.

Unit 5: ESR Spectroscopy- Principle, Hyperfine splitting, Instrumentation and applications. NMR Spectroscopy- Principle, Theory of Proton Magnetic resonance and Instrumentation. NMR parameters- Chemical shifts, spin-spin splitting, Intensity and line width and applications- Magnetic resonance imaging. Mass spectroscopy- Principle, Instrumentation, Ionization techniques, Electron impact and chemical Ionization, Ion desorption and evaporation methods, Magnetic and electric sector analyzers, detectors (Faraday cup). X-ray crystallography- Principle, Bragg's equation, determination of crystal structure-Rotating crystal method and Powder method, and applications.

Reference book:

Practical Biochemistry- Principles and techniques- by Keith Wilson and John Walker.

Text book:

Biophysical techniques, by K.Upadhyay, A. Upadhyaya and N.Nath. Himalaya publishing house.

BTM 322

L:3, T:1

CHEMICAL REACTION ENGINEERING

Kinetics of homogeneous reactions: concentration – dependent term of a rate equation, temperature - dependent term of a rate equation, searching for a mechanism.

Interpretation of Batch reactor data: constant volume batch reactor, varying volume batch reactor, temperature and reaction rate, search for a rate equation. Introduction to reactor design.

Ideal reactors for a single reaction: ideal batch reactors, steady-state Mixed flow reactors, steady-state Plug flow reactors, Design for single reactions: size comparison of single reactors, multiple reactor systems, recycle reactor, autocatalytic reactions. Design for parallel reactions.

Potpourri of multiple reactions: irreversible first-order reactions in series, first-order followed by zero-order reaction, zero-order followed by first-order reaction.

Temperature and Pressure effects: Single reactions, multiple reactions.

Basics of non-ideal flow: E, the age distribution of fluid, the RTD, conversion in non-ideal flow reactors. The dispersion model: axial dispersion, correlations for axial dispersion, chemical reaction and dispersion. The tanks in series model: pulse response experiments and the RTD, chemical conversion.

Heterogeneous reactions, solid catalyzed reactions: the rate equation for surface kinetics, pore diffusion resistance combined with surface kinetics, porous catalyst particles, performance equations for reactors containing porous catalyst particles, experimental methods for finding rates.

TEXT BOOKS:

1. Levenspiel O, "Chemical Reaction Engineering", John Wiley & Sons.
2. Smith, J.M., "Chemical Engineering Kinetics", McGraw-Hill Book Co.
3. Fogler, H.C., "Elements of Chemical Reaction Engineering", Prentice-Hall, Inc

BTM 323

L: 3 T: 1

BIOPROCESS ENGINEERING

Introduction to Biotechnology and Bioprocess Engineering – Regulatory constraints in Bioprocess.

Stoichiometry of microbial growth and product formation – Elemental balances – Degree of reduction – Prediction of yield coefficients.

Enzyme Kinetics – Michaeli's-Menten Equation and determination of kinetic coefficients –Effect of pH and temperature.

Principles and mechanisms of media and air sterilization – Batch and continuous sterilization of media.

Cell kinetics and Fermentor design: Batch growth cultivation – Batch, continuous, and plug flow fermentors – Monod growth kinetics in continuous culture and evaluation of coefficients – Fed batch operation – Chemostat with cell recycle – Multistage chemostat systems.

Alternative Bioreactors: Fluidized bioreactor – Air lift fermentor – Bubble column reactor and Membrane reactor.

Bioreactor instrumentation and control.

Text Books:

1. M.L.Shuler and F.Kargi, Bioprocess Engineering 2nd Ed. Prantice Hall India, New Delhi.
2. J.M.Lee, Biochemical Engineering, Practice–Hall 1992.

Reference Books:

1. D.G.Rao Text Book of Biochemical Engineering, Tata McGraw Hill, New Delhi, 2004.
2. E.Bailey and D.F.Ollis, Biochemical Engineering Fundamentals, 2nd Ed. McGraw Hill, 1986.

BTM 324

L:4, T:0

INDUSTRIAL BIOTECH PRODUCTS

Microbial Processes: Introduction, types of fermentations, components of industrial microbial process. Source of industrial cultures, maintenance & improvement of culture for better production. Primary & secondary metabolites, Idiophase & Trophophase.

Alcohol fermentation: Production of industrial alcohol- Biosynthetic mechanism- Recovery- latest developments. Brewing – malting – grain alcohol, wine manufacture- Glycerol fermentation.

Acetic acid production- Biochemistry of acetic acid production- Vinegar manufacture- spoilage of vinegar.

Fermentative production of citric acid & lactic acid. Fermentative production of Acetone & Butanol.

Microbial foods: mushrooms, cheese.

Amino acids, vitamins, Antibiotics – Glutamic acid, vitamin B₁₂, Penicilin & streptomycin, latest developments.

Industrial enzymes: submerged & solid culture for enzyme production, production of amylase, protease, cellulase, & lipase.

Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines

Text Books:

1. Industrial microbiology-Cruger & cruger
2. Industrial microbiology-Caseda
3. Industrial microbiology-A.H.Patel

Reference:

1. Prescott & Dunn - Industrial microbiology

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L:3, T:1

ENVIRONMENTAL BIOTECHNOLOGY

Introduction to environmental biotechnology- waste, pollutants, disposal standards, health hazards due to pollution, tolerance limits, clean technologies, hierarchy of pollution management (source reduction, recycle, treatment and disposal), bio magnification, green house effect, renewable energy sources

Air pollution control- Classification and properties of air pollution, sources and impacts, engineered systems for air pollution control, control devices for particulate contaminants- gravitational settling chamber, cyclones, wet collectors, electrostatic precipiters etc.

Waste water treatment – characteristics of domestic and industrial waste waters, conventional waste water treatment procedures(STP), biological components in waste water treatment processes, trickling filter systems (aerobic attached growth process), activated sludge process (suspended growth process), advanced waste water treatment processes (UASB and fixed film reactors) sludge digestion (anaerobic digesters), Biomethanation process)

Solid waste management – sources and classification, engineered systems for solid waste, management, major types of solid waste treatment processes- land filling, sanitary land filling. Hazards of land filling, composting (aerobic and

anaerobic) as a method of solid waste disposal, incineration as a method of solid waste disposal, analysis and design of biowaste used in solid waste treatment

TEXT BOOKS:

1. Environmental pollution control engineering . C.S.,Rao, Jew age International Pvt Ltd.
2. Environmental engineering, Howard S. Peavy, Donald.R. Rowe and George Tchobanoglous, Mc Graw Hill
3. Waste water engineering: treatment, disposal and reuse, Metcalf and Eddy, McGraw Hill
4. Integrated solid waste management, George Tchobanoglous, Hilary Theisen and Samuel A. Vigil McGraw Hill

REFERENCES:

1. Environmental Biotechnology: Principles and applications, Bruce E. Rittmann, Perry. L. Mc Carty, Mc Graw Hill
2. Waste water treatment for pollution control, Soli J. Arceivala, Tata Mc Graw Hill Publishing company Ltd.
3. Environmental engineering – A design approach, Arcadio P. Sincero and Gregoria A. Sincero, Prentice Hall of India Pvt Ltd.

BTM 326

L:3, T:1

PHARMACEUTICAL BIOTECHNOLOGY

Introduction- Development of Drug and Pharmaceutical Industry, Therapeutic agents – their uses and economics, Regulatory aspects.

Drug metabolism and Pharmacokinetics- Metabolism, Physico-chemical principles, radioactivity, Pharmacokinetics action of drugs on human bodies.

Important Unit Processes and their applications: Bulk drug manufacturing, Types of reactions in bulk drug manufacturing and processes, Special requirements for Bulk Drug manufacture.

Manufacturing Principles: Wet granulation, Dry granulation or slugging, Direct compression, Tablet presses. Coating of tablets, capsules. Sustained action dosage. Forms- Parental solutions, oral liquids, injections, ointments. Various topical drugs and pharmaceuticals, Packaging- Packaging techniques, Quality management and GMP.

Pharmaceutical products and their control- Therapeutic categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals- Hormones.

REFERENCE BOOK:

Remington's Pharmaceutical Sciences, Mark publishing and Co.

TEXT BOOKS:

1. Leon and Lachman et al- Theory and Practice of Industrial pharmacy.
2. Cooper and Gunn's – Dispensing Pharmacy.

Chemical Reaction Engineering Laboratory

- a) Determination of the order of a reaction using a batch reactor and analyzing the data by a) differential method b) integral method.
- b) Determination of the activation energy of a reaction using a batch reactor.
- c) Enzyme kinetics in a batch reactor and estimation of Michaelis–Menten coefficients.
- d) To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
- e) To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
- f) To determine the order of a reaction and rate constant using a Tubular reactor.
- g) Determination of RTD and dispersion number in a Tubular reactor using a tracer.
- h) Axial mixing in a packed bed : Determination of RTD and dispersion number for a packed bed using a tracer.
- i) Performance of reactors in series:
 - (i) PFR followed by a CSTR
 - (ii) CSTR followed by a PFR

BIOANALYTICAL - LAB

1. Calibration of pH meter and preparation of buffers using pH meter
2. Paper chromatography of sugar
3. Two dimensional paper chromatography of amino acids
4. Thin layer chromatography of lipids
5. Estimation of reducing sugars using DNS reagent
6. Isolation of DNA
7. Isolation of RNA
8. Electrophoretic separation of proteins
9. Gel filtration
10. Ion exchange of biomolecules and fraction collection
11. Native PAGE for separation of proteins
12. Determination of molecular weights by SDS-PAGE
13. Estimation of turbidity by Nephelometer
14. Separation of biomolecules by GLC

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L-4, T-0

ENZYME TECHNOLOGY

Introduction to enzyme technology, holoenzymes, non proteinaceous enzymes, extremozymes, advantages of enzyme as biocatalysts, mechanism of enzyme action.

Immobilization of enzymes and cells, distinctive advantages of immobilization assisted bioprocesses. Methods of immobilization (physical and chemical) comprising types of cell and enzyme immobilizations.

Basics of enzyme kinetics of immobilized enzymes, external and internal diffusional characteristics of immobilized systems

Major types of enzyme reactors - Competitive and non – competitive inhibition of enzymes

Basic concepts of Enzyme Engineering – Introduction to biosensors

Applications of enzymes:

- a) Industrial applications
- b) Medical and pharmaceutical applications
- c) Food processing applications

TEXT BOOKS:

1. Applied biochemistry and bioengineering. Vol I Ed Wingard. L.B. Katchalski – Katzir. ER.Goldstein, L.Academic press
2. Biochemical engineering fundamentals. Bailey and Ollis
3. Fundamentals of Enzymology, 3rd Edition Price N.C. and Stevens, L. Oxford University press
4. Immobilization of enzymes and cells: Methods in Biotechnology.Vol I Bickerstaff. G.F

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L:3, T:1

BIOINFORMATICS

UNIT – I Major Bioinformatics Resources:

Knowledge of the following databases with respect to: organization of data, retrieval of data using text-based search tools, sources of data method for deposition of data to databases.

Introduction, Primary & Secondary database,

Nucleic acid sequence databases: GenBank, EMBL, DDBJ
Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD
Genome Databases at NCBI, EBI, ExPASy, TIGR, SANGER
Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI
Sequence and Structure Databases: PDB, MMDB
Metabolic pathways databases such as KEGG, EMP.

UNIT – II Sequence Alignment and Database Searching:

Introduction- Collection, annotation and alignment of sequences. Basic concepts of sequence similarity, identity and homology. Scoring matrices – PAM and BLOSUM, gap penalties, Database similarity searching, FASTA, BLAST.

Pairwise sequence alignments: basic concepts of sequence alignment, Dynamic programming- Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments

Multiple sequence alignments (MSA): the need for MSA, basic concepts of MSA (e.g. progressive, hierarchical etc.). Algorithm of CLUSTALW. Use of HMM method, concept of dendograms and its interpretation.

UNIT – IV Taxonomy and phylogenetic analysis:

Basic concepts in taxonomy and phylogeny; molecular evolution; nature of data used, Definition and description of phylogenetic trees and various types of trees, tree building and tree evaluation methods, Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Maximum likelihood algorithm.

UNIT – V: Secondary structure prediction methods- ChouFASMAN/GOR, Nearest neighbor, Neural network

UNIT – VI Genome Mapping and Applications:

Human genome project, application of genome mapping, DNA microarrays.

TEXT BOOKS:

1. Introduction to Bioinformatics. T.K. Attwood and P.J. Parry – Smith. Pearson Bioinformatics.
2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

REFERENCES:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
2. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
3. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman H. Rashidi and Lukas K. Buehler CAC Press 2000.
4. Algorithms on Strings Trees and Sequences Dan Gusfield. Cambridge University Press

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L: 3 T: 1

BIOPROCESS DESIGN

Basic function of a Bioreactor for plant and microbial or animal cell culture.

Factors involved in bioreactor design and principal operating characteristics of bioreactors.

Body construction – construction material, temperature control.

Aeration and agitation – agitators (impellers), stirrer glands and bearings, baffles, aeration system (spargers).

Valves and steam traps used in fermentation industries.

Scale up: Basic concepts, problems related to the scale up of the microbial processes.

Designing of other fermentation vessels.

TEXT BOOKS:

1. M.L.Shuler and F.Kargi, Bioprocess Engineering 2nd Ed. Prantice Hall India, New Delhi.
2. Stanbury , PFA , Whitaker & Hall Pergamon. Principles of fermentation technology.

REFERENCE BOOKS:

1. D.G.Rao Text Book of Biochemical Engineering, Tata McGraw Hill, New Delhi, 2004.
2. E.Bailey and D.F.Ollis, Biochemical Engineering Fundamentals, 2nd Ed. McGraw Hill, 1986.

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L:3, T:1

INSTRUMENTATION AND PROCESS CONTROL

Introduction to process control – process variables – degrees of freedom. Process modelling– Liquid level system-Linearization example– Two-tank liquid-level system– interacting and non-interacting systems–Thermal process–Mixing process–Heat exchanger–Distillation column. Dynamics of 1st and 2nd order systems, Batch process and Continuous process. Self-regulation. Control systems with inverse response.

Final control-final control operation, signal conversions-analog electrical signals-digital electrical signals, pneumatic signals, Electrical actuators–electric linear motors, Hydraulic systems-basic principle- hydraulic pumps- hydraulic actuators-pressure control valves- accumulator- directional control valves, Pneumatic systems compressor-dryer-tank-actuators. I/P, P/I converters, Valve positioner. Switches-different types, Relays electromechanical-solid state relays.

Control valves – construction, characteristics, different types –ball, gate, butterfly, and other types, Valve sizing, cavitation and flashing, control valve noise and methods of its reduction. Advanced Control Strategies-Cascade control-Feed forward control-Ratio Control-Internal model control- Selective control schemes- Split-range control-Adaptive control -Inferential control.

Process identification-purpose-step testing-pulse testing-ATV method-Least squares method-relationship among time, Laplace, and frequency domains. Multivariable control-control of interacting systems-response of multi-loop control system-non-interacting control-stability of multivariable systems

TEXT BOOKS:

1. G. Stephanopoulos: *Chemical Process Control: An Introduction to Theory and Practice*, Pearson Education, Delhi, 2004
2. D. R. Coughanowr, *Process Systems Analysis and Control, 2nd ed.*, McGraw Hill, New York, 1991
3. C. D. Johnson, *Process Control Instrumentation Technology, 7th ed.*, Pearson Education, Delhi, 2003
4. M. L. Luyben and W. L. Luyben, *Essentials of Process Control*, Tata McGraw Hill, New York, 1997

Reference Books:

1. C. T. Kilian, *Modern Control Technology Components and Systems, 2nd ed.*, Thomson Asia, Singapore, 2001
2. D. M. Considine, *Process/Industrial Instruments and Controls Handbook, 4th ed.*, McGraw-Hill, New York, 1993
3. P. Harriot, *Process Control*, Tata McGraw-Hill, New Delhi, 1972
4. D. E. Seborg,, T. F. Edgar, and D. A. Mellichamp, *Process Dynamics and Control, 2nd ed.*, John Wiley & Sons, New York, 2004

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L:3, T:1

DOWN STREAM PROCESS

Introduction: An Overview of bioseparation engineering, nature of bioseparation, Role and Importance of downstream processing in biotechnological processes, Problems and requirements of bioproduct purification, Economics of downstream processing in Biotechnology physico-chemical basis of bioseparation processes.

Separation of Insoluble products: Filtration and micro filtration, cross-flow filtration, centrifugation (batch, continuous, basket), Coagulation and flocculation, gravity sedimentation, settling, decanting.

Cell disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods

Separation of Soluble Products: Extraction, precipitation, adsorption, dialysis, reverse osmosis, ultra filtration, Cross- flow ultra filtration and micro filtration, electrophoresis and various kinds of chromatography and electro dialysis.

Products polishing: Crystallization and drying.

New and Emerging techniques: Pervaporation, Super liquid extraction, Foam based separation.

Product recovery trains – Enzymes, antibiotics, ethanol, citric acid, monoclonal antibody

TEXT BOOKS:

1. Bioprocess Engineering Michael L. Shuler Fikret Kargi, Prentice Hall of India
2. "Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984)

REFERENCE:

1. "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw-Hill (1986)
2. "Comprehensive Biotechnology" Vol.2 Ed.: M. Moo-Young (1985)
3. " Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990.

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L:3, T:1

BASIC BIOMEDICAL ENGINEERING

Section I

General Introduction to Biomedical Engineering. Application of Engineering in Medicine. Electrical Potentials in the human body. Neuromuscular system: neurons, synapses and muscles, electrical properties of nerves and muscles, problems and diagnostics. Cardiovascular System: anatomy & physiology of heart, ECG and the cardiac cycle, problems and solutions to electrical problems in the heart, blood and vascular modeling, haemodynamics, vascular disease management, Skeletal System (including Prosthetics).

Section II

Biomaterials and Implantable sensors, testing of Biomaterials in vitro and in vivo. Excretory, system (including Dialysis): renal anatomy & Physiology, the nephron, dialysis machines & mass transport. Medical Imaging: X-rays, design considerations of X-ray tubes, medical Image processing – projections, 3D-2D, slice identification, CAT, NMR, MRI, PET / SPECT. Cellular engineering and genetic engineering – introduction: Ethical consideration in Medical Research.

TEXT / REFERENCES:

1. J.T. Bushberg, J.A. Scibert, E.M. Leidholdt (Jr), J.M.Boone: The Essentials Physics of medical Imaging, Lippincott Williams and Wilkins, USA, 2002.
2. R.B. Buxton: Introduction to Functional Magnetic Resonance Imaging: Principals & Techniques, Cambridge Univ, Press, UK, 2002.

3. J. Enderle, S. Blanchard & J. Bronzino (Eds): Introduction to Biomedical Engineering, Academic Press 2000.
4. John G. Webster (Ed): Medical Instrumentation – Application and Design, 3rd Ed. John Wiley & Sons, 1989.
5. J.B. West. (Ed) Best and Taylor's Physiological Basis of Medical Practice, 11th Ed., Williams and Wilkins, Baltimore 1985.
6. Y.C. Fung: Biomechanics, Springer – Verlag, New York, 1981.

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L:3, T:1

METABOLIC ENGINEERING

UNIT I: INTRODUCTION

Metabolic regulation in metabolic engineering. Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction Differential regulation by isoenzymes, Feed back regulation.

UNIT II: SYNTHESIS OF PRIMARY & SECONDARY METABOLITES

Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feed back regulation, Limiting accumulation of endproducts. Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation bypassing control of secondary metabolism.

UNIT III: REGULATION OF ENZYME PRODUCTION

Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feed back repression, Catabolite Repression, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways.

UNIT IV: BIOCONVERSIONS

Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, sequential bioconversions.

UNIT VI : METABOLIC FLUX

Integration of anabolism and catabolism, metabolic flux, material balance, kinetic types, equilibrium reaction. distribution, Metabolic flux analysis and its applications, Thermodynamics of cellular processes.

UNIT VI: APPLICATIONS OF METABOLIC ENGINEERING

Application in pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion.

TEXT BOOKS:

1. Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons 1980.
2. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.

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BIOPROCESS DESIGN LAB

1. Isolation and characterization of industrial cultures for use as biocatalysts in bioprocesses
2. Analysis of raw materials used in common industrial bioprocesses
3. Parameter optimization studies in bioprocesses eg. Ethyl alcohol, amino acid production etc.
4. Product purification in bioprocess studies. Eg. Enzyme production (amylase, protease etc).
5. Cell growth kinetics by batch and continuous modes
6. Measurement of Volumetric Oxygen transfer coefficient
7. Cell immobilization protocols
8. Immobilized bioprocess with cells and enzymes
9. Filter efficiency of common air filters
10. Heat inactivation of microbial cells, thermal death rate

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PROCESS INSTRUMENTATION AND CONTROL LAB

1. Study the response of bare thermometer using step input.
2. Study the response of bare thermometer using impulse input.
3. Study the response of first order system for a step input.
4. Study the response of non interacting system for a step input.
5. Study the response of non interacting system for a impulse input.
6. Study the response of interacting system for a step input.
7. Study of control valve coefficient.
8. Study of inherent valve characteristics of control valve.
9. Calibration of pressure guage using U tube manometer.
10. Study the open loop response by manual method (Temperature control Trainer)

Value of money equivalence: value of money, equations for economic studies , equivalence, types of interest, discrete, continuous. Annuities: relation between ordinary annuity and the periodic payments . continuous cash flow and interest compounding, present worth of an annuity , perpetuities and capitalised costs. Bonds and debentures: value of a bond and yield rate.

Depreciation: types and various methods of calculating depreciations, depreciation accounting. Cost accounting: basic relationship in accounting, balance sheet and income statements. Cost estimation: cash flow for industrial operations, factors affecting investments and production costs – estimation of capital investment , cost indices, cost factors in capital investment, methods of estimating capital investment. estimation of total product cost: manufacturing costs and general expenses.

Concepts of Management and Organisation – Functions of Management Designing Organizational Structures : Basic concepts related to Organisation – Departmentation and Decentralization.

Plant location, definition, factors affecting the plant location. Plant Layout – definition, objectives, types of production, types of plant layout – various data analyzing forms-travel chart.

Work study - Definition, objectives, method study - definition, objectives, steps involved-various types of associated charts-difference between micromotion and memomotion studies.

Materials Management-Objectives, Inventory – functions, types, associated costs, inventory. Inspection and quality control, types of inspections - Statistical Quality Control-techniques.

Text books:

- a) Plant design and economics for chemical engineers(fourth edition) by Max S Peters and Klans D Timmerhans Mc Graw Hill Book Company.
- b) Process Engineering Economics by Herbest E Schweyer Mc Graw Hill Book Company.

TEXT BOOKS:

1. Amrine, Manufacturing Organization and Management, Pearson, 2nd Edition.
2. Industrial Engineering and Management O.P. Khanna Dhanpat Rai.

REFERENCES :

1. Panner Selvam, Production and Operations Management, PHI, 2004.
2. Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2005.

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L:4, T:0

PLANT CELL AND TISSUE CULTURE

UNIT I: Fundamentals of plant tissue culture: laboratory organization, sterilization methods, culture medium and growth regulators.

Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

UNIT II: Cell culture: single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

UNIT III: Somatic embryogenesis and synthetic seeds: principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation

UNIT IV: Somoclonal variations – its genetic basis and application in crop improvement- cell line selection for resistance to herbicides, stress and diseases. **Haploid production and its advantages-** androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture.

UNIT V: Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization

Production of disease free plants- meristem tip culture- virus indexing.

UNIT VI: Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

UNIT VII: Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations.

Automation and Economics of tissue culture.

TEXT BOOKS

1. Plant tissue culture – Kalyan Kumar De – New Central Book Agency

REFERENCE

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.
2. Plant tissue culture- theory and practice. Bhojwani, SS & Razdan MK.Elsevier
3. Plant tissue and Cell culture. Street, HE.Blackwell

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L:4, T:0

GOOD MANUFACTURING PRACTICES

Section I

EC structure and tools, Directives Decision on Regulation (and how to find them), Biotechnology and the law: summary of some current legislation in fore / Cartagna, Protocol 1989 EDA rules. Good laboratory practice, Guidelines for Microbial and animal cell cultivation, Safety and the genetic manipulation of organisms, scientific procedure using animals, Radiation health and safety.

Section II

Patents and biotechnology, Applying for marked authorization for medical products, Manufacture and evaluation of medicinal products product, Regulation of biotechnology in the food industry, A general comment on the biotechnological production of chemicals other than medicines and food ingredients.

Reference Books:

- 1) Compendium of Good Practices in Biotechnology, BIOTOL series
- 2) Patent Strategy for Researchers and research managers – Knight, Wiley Publications.
- 3) Role of Patent and Patent information in Biotechnology inventions – Document of The international Bureau of world Intellectual Prosperity organization -1994
- 4) D. A. Shapton and R.G Board, 'Safety in Microbiology,' Academic Press, London 1972

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L:4, T:0

INTELLECTUAL PROPERTY RIGHTS, COMMERCIALIZATION OF BIOTECHNOLOGY

General Introduction: Patent claims, the legal decision – making process, ownership of tangible and intellectual property. WTO with reference to biotechnological affairs, TRIPs. Basic Requirements of Patentability Patentable subject matter, novelty and the public domain, non obviousness. Special issues in Biotechnology Patents. Recent Developments in Patent System and Patentability of biotechnological inventions.

Plant biotechnology Indian patents and foreign patents, Plant variety protection act, the strategy of protecting plants. Patent Litigation different Doctrines. IPR issues in Indian Context Role of patent in pharmaceutical industry.

Why there is a need to commercialize biotechnology. Creating and marketing the image of the biotechnology Company. Art of negotiation & effective communication. Role of venture capitalism, business plan, selection of CEO and personnel, real estate for a biotech start-up.

Role of a biotechnology manager, Role of Research & development University-industry technology transfer arrangements, how and why a biotech company can benefit. Indian and foreign prospective of biotechnology, and current challenges for the biotechnology based products.

TEXT / REFERENCE BOOKS:

- 1) The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
- 2) Intellectual property rights – Ganguli – Tat McGrawhill
- 3) Intellectual property right – Wattal – Oxford Publishing House.
- 4) Positioning by All Rise and Jack Trout (1986), Warner Books.
- 5) Biotechnology: The science & the business by V. Moser & R.E. Cape (1999) Harwood.
- 6) Latest review articles and papers on the subject.

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PLANT CELL AND TISSUE CULTURE LAB

1. Sterilization methods
2. Preparation of stock solutions
3. preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micropropagation and plant plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture.

TEXT BOOKS:

1. Plant cell culture: A practical approach. Dixon. R.A
2. Plant cell and tissue culture – a laboratory manual, Rienert, J and Yeoman. M.M. Springer verlag
3. Plant tissue culture; theory and practice. Bhojwani. S.S.