Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

2nd Year - Semester III

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	T	P	Total	
HU-301	HU	Values & Ethics in Profession	3	0	0	3	3
CH(BT)-301	Engg. Science-I	Basic Environmental Engineering & Elementary Biology for BT	3	0	0	3	3
CH(BT)-302	Basic Science	Chemistry -2 for BT	3	1	0	4	4
BT-301	Engg. Science-II	Thermodynamics and Kinetics	3	0	0	3	3
BT-302	Professional Core	Biochemistry	3	1	0	4	4
BT-303	Professional Core	Microbiology	3	1	0	4	4
Total of Theory						**21**	**21**
B. PRACTICAL							
CH(BT)-381	Engg. Science	Basic Environmental Engineering & Elementary Biology Lab	0	0	3	3	2
CH(BT)-382	Basic Science	Chemistry -2 Lab for BT	0	0	3	3	2
BT-391	Professional Core	Biochemistry Lab	0	0	3	3	2
BT-392	Professional Core	Microbiology Lab	0	0	3	3	2
Total of Practical						**12**	**8**
Total of Semester						**33**	**29**

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

2nd Year - Semester IV

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	T	P	Total	
M (CS)-401	Basic. Sc.	Numerical Methods	2	1	0	3	2
CH-401	Basic Sc.	Industrial Stoichiometry	3	1	0	4	4
CH-402	Engg. Sc.	Transfer Operation I	3	0	0	3	3
BT-401	Prof. Core	Molecular Biology	3	1	0	4	4
BT-402	Prof. Core	Industrial Microbiology and Enzyme Technology	3	1	0	4	4
Total of Theory						**18**	**17**
B. PRACTICAL							
HU-481	HU	Technical Report Writing & Language Lab Practice	0	0	3	3	2
M (CS)-491	Engg. Sc.	Numerical Methods	0	0	2	2	1
CH-481	Engg. Sc.	Transfer Operation I Lab	0	0	3	3	2
BT-491	Prof. Core	Molecular Biology Lab	0	0	3	3	2
BT-492	Prof. Core	Fermentation Technology Lab	0	0	3	3	3
Total of Practical						**14**	**10**
Total of Semester						**32**	**27**

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

3rd Year-Semester V

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	T	P	Total	
HU-511	**HU**	**Principles & Practices of Management**	**3**	**0**	**0**	**3**	**3**
BT-501	**Prof.Core**	**Genetics**	**3**	**1**	**0**	**4**	**4**
BT-502	**Prof.Core**	**Bioinformatics**	**3**	**1**	**0**	**4**	**4**
CH-515	**Prof.Elec.**	**Transfer operation -II**	**3**	**1**	**0**	**4**	**4**
CS-515	**Free. Elec.**	**Data Structure & Algorithm (Java and C++)**	**3**	**0**	**0**	**3**	**3**
Total of Theory						**18**	**18**
B. PRACTICAL							
BT-591	**Prof.Core**	**Genetics Lab**	**0**	**0**	**3**	**3**	**2**
BT-592	**Prof.Core**	**Bioinformatics Lab**	**0**	**0**	**3**	**3**	**2**
CH-584	**Prof. Elec**	**Transfer operation Lab-II**	**0**	**0**	**3**	**3**	**2**
CS-584	**Free. Elec.**	**Data Structure & Algorithm Lab**	**0**	**0**	**3**	**3**	**2**
Total of Practical						**12**	**8**
Total of Semester						**30**	**26**

3rd Year-Semester VI

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	**T**	**P**	**Total**	
HU-611	**HU**	**Production & Operations Management**	**2**	**0**	**0**	**2**	**2**
BT-601	**Prof. Core.**	**Recombinant DNA Technology**	**3**	**0**	**0**	**3**	**3**
BT-602	**Prof. Core.**	**Immunology**	**3**	**0**	**0**	**3**	**3**
BT-603	**Prof. .Elec.**	**Plant Biotechnology**	**3**	**0**	**0**	**3**	**3**
BT-604	**Prof. Elec.**	**604A: Bioseperation Technology 604B: Molecular Modeling & Drug Designing 604C: Biophysics of Macromolecules 604D: Biosensor & Diagnostics 604E: Biofertilizer & Biopesticide**	**3**	**0**	**0**	**3**	**3**
CS-615	**Free. Elec.**	**Data Base Management System and Computer Networking**	**3**	**0**	**0**	**3**	**3**
Total of Theory						**17**	**17**
B. PRACTICAL							
BT-691	**Prof. Core.**	**Recombinant DNA Technology Lab**	**0**	**0**	**3**	**3**	**2**
BT-692	**Prof. Core.**	**Immunology Lab**	**0**	**0**	**3**	**3**	**2**
BT693	**Prof. Elec**	**Plant Biotechnology Lab**	**0**	**0**	**3**	**3**	**2**
CS-684	**Free. Elec.**	**Data Base Management System and Computer Networking Lab**	**0**	**0**	**3**	**3**	**2**
BT-694		**Seminar (Review and Presentation by PPT)**	**0**	**0**	**1**	**1**	**1**
Total of Practical						**13**	**9**
Total of Semester						**30**	**26**

***Training in a suitable industry, R&D Organization, Reputed Laboratory or Research Institute for 6 to 8 weeks to be arranged during summer vacation.**

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

Proposed

4th Year-Semester VII

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	**T**	**P**	**Total**	
BT-701	Prof.Core.	Bioreactor Design and Analysis	3	0	0	3	3
BT-702	Prof.Core	Animal Cell Culture & Animal Biotechnology	3	0	0	3	3
BT-703	Prof.Elec.	Food Biotechnology	3	0	0	3	3
BT-704	*Prof.Elec.	704A: Environmental Biotechnology & Pollution Control 704B: Modeling & Simulation of Bioprocesses 704C: Biomaterials 704D: Biometalergy 704E: Proteomics & Protein Engineering 704F: Human Genomics	3	0	0	3	3
CHE-701	Free. Elec.	Process Instrumentation & Control	3	0	0	3	3
Total of Theory						15	15
B. PRACTICAL							
HU-781	HU	Group Discussion	0	0	2	2	2
BT-791	Prof. Core.	Bioreactor Design & Analysis Lab	0	0	3	3	2
BT-792	Prof. Elec.	Food Biotechnology Lab	0	0	3	3	2
CHE-783	Free Elec.	Process Instrumentation & Control Lab	0	0	3	3	2
BT-793		Seminar (Review and Presentation by PPT of a Research Paper)	0	0	2	2	1
BT-794		Project Work -I (Project Repot-I)	0	0	6	6	3
BT-795	Industrial project/training (Report, Poster Presentation & Viva Voce)		6 to 8 weeks				2
Total of Practical						19	14
Total of Semester						34	29

*Any one from the list

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

4th Year-Semester VIII

A. THEORY							
Code	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
			L	**T**	**P**	**Total**	
HU(BT)-801	**HU**	**Bioethics, Biosafety, IPR & Entrepreneurship in Biotechnology**	**3**	**0**	**0**	**3**	**3**
BT-801	**Prof. Elec.**	**Medical & Pharmaceutical Biotechnology**	**3**	**0**	**0**	**3**	**3**
BT-802	****Free Elec.**	**802A: Renewable Energy Technology 802B: Tissue Engineering 802C: Biomedical Engineering 802D: Post Harvest Technology 802E: Metabolic Engineering**	**3**	**0**	**0**	**3**	**3**
Total of Theory						**9**	**9**
B. PRACTICAL							
BT-891	**Design Lab /Industrial problem/ Industrial related training**		**0**	**0**	**6**	**6**	**4**
BT-892	**Project work-II**		**0**	**0**	**12**	**12**	**4**
BT-893	**Project Report-II Report and Defense Seminar by PPT**		**0**	**0**	**0**	**0**	**2**
BT-894	**Grand Viva (Comprehensive Viva Voce)**						**3**
Total of Practical						**18**	**13**
Total of Semester						**27**	**22**

**** Any one from the list**

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Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

2nd Year - Semester III

THEORY

HU-301: Values & Ethics in Profession **L-T-P= 3-0-0**

Contracts: 3L

Credits- 3

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development

Energy Crisis: Renewable Energy Resources

Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics

Appropriate Technology Movement of Schumacher; later developments

Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.

Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation. Human centered Technology.

Ethics of Profession:

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:

Values Crisis in contemporary society

Nature of values: Value Spectrum of a good life

Psychological values: Integrated personality; mental health

Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.

Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity

Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

CH(BT)-301: Basic Environmental Engineering and Elementary Biology for BT

L-T-P = 3-0-0

Module I: 10L

Basic ideas of environment, Mathematics of population growth and associated problems, Environmental degradation: Acid rain, toxic element, particulates, noise pollution, air pollution and its effect on man. Overall methods for pollution

prevention, environmental problems and sustainable development, components of environment Ecological balance and consequence of change: Effect of abiotic factor on population, flow chart of different cycles with only elementary reaction [oxygen, nitrogen, phosphate, sulphur], food chain [definition and one example of each food chain]

Module II : 10L

Sources & effect of different air pollutants, smog-photochemical smog, depletion of ozone layer, green house gas & global warming, Engineering Systems for air pollution control- basic concepts of control mechanisms, devices and their design; Engineering Systems for water pollution control- basic concepts of control mechanisms, devices and their design; primary, secondary and tertiary treatment process, natural purification system.

General knowledge of laws, regulations and rules concerning air, water, soil and noise pollution.

Familiarity with Environmental protection act. Environmental impact assessment.

Module III: 10L

Basis of ecology, ecosystem and biosphere, ecological components (Biotic and abiotic); Interdependence of life forms, examples of cohabitation of organisms, symbiosis and parasitism, concepts of food webs, Biodiversity, Bioterrorism.

Module IV: 10L

The Cell: Current Concepts & Origin, difference between pro and eukaryotic cells, cell organelles, Nuclear Components, Cell Cycle; The Stages of Mitosis, Abnormal Cell Division: Mutagens (types and example each) and mutations (basic mechanism of point and chromosomal mutations)

Text Books:

1. C.S Rao, Environmental pollution and control Engeering
2. A K Dey, Environmental chemistry
3. Concepts in Biology By E.D.Enger & F.C.Ross, 9th Ed Tata McGraw Hill

Reference Book:

1. B S Chauhan Environmental pollution
2. Biology by P.H.Raven et.al, 5th Ed. WBC McGraw Hill

CH(BT)-302: Chemistry –II (for Biotechnology) **L-T-P= 3-1-0**

At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module -I (10L): Basic Stereochemistry & Spectroscopy:

Introduction to Chemistry: Structure of water molecules. Basic concepts of pH, buffer, pKa. Weak inter-molecular interactions in biomacromolecules**. Stereochemistry:** optical isomer (d, l, and D, L and R, S nomenclature), geometrical isomer (cis, trans), basic idea of Fischer (glucose). Newman and Sawhorse (butane and cyclohexane), Haworth (glucose) projection formula. **Spectroscopy:** Introduction, absorption and emission spectroscopy, Lambert–Beer law. Basic concepts and principles and applications of UV and visible spectroscopy.

Mod-II (10L): Structural Chemistry of Carbohydrates, Lipids, Vitamin, Hormone and Minerals:

Chemistry of Carbohydrates: Mono, di and Polysaccharide (glycogen, starch, cellulose), Classification, Structure (based on Fisher, Haworth projection formulae) and Function. **Chemistry of Lipids:** Classification, Structure and Function

(Fatty acids, Fats and oils, phospholipids, sphingolipids, glycolipids, cholesterol). **Vitamins, hormones and minerals:** classification, Structure and Function.

Module- II (10L): Structural Chemistry of Amino Acids, Proteins and Nucleic acids:

Chemistry of Proteins: Chemistry of amino acids and peptides. Peptide bond, pH titration curve for amino acids. Primary, secondary (alpha helix, beta sheet, Ramachandran plot), tertiary (Ribonuclease); quaternary and super secondary structure of protein, Protein denaturation and Functions. **Chemistry of Nucleic Acids:** Chemistry of Nucleoside, Nucleotide and nomeclature**.** Primary, secondary structure and function of DNA and RNA, Denaturation and renaturation kinetics of DNA.

Module-IV (10 L): Organic Reaction Mechanism & Polymer:

Basis of Organic Reactions Mechanism: SN1, SN2, E1 and E2 reactions, Addition reactions, Rearrangement reactions, Hoffmann and Saytzeff rules, Markonikoff rule and Kharash effect, Diels-Alder reaction, aromatic electrophilic substitution. Basic concepts of biopolymer and biomaterials with context of nanotechnology.

Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials.
Revision: 4L (1 for each module)

Textbook:

1. Lehninger Principles of Biochemistry by Nelson and Cox, McMillan publishers
2. Van Holde, Principles of Physical Biochemistry, Pearson
3. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
4. Biochemistry by Zubey. Wm. C. Brown publishers

Reference books:

1. David Friefelder, Physical Biochemistry,
2. Practical Biochemistry Principles and techniques: Ed Wilson and Walker, Cambridge University Press
3. Biochemical Calculations by Irwin H. Segel, John Wiley & Sons

BT-301: Thermodynamics and Kinetics **L-T-P = 3-0-0**

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Module I: 10L

Basic Concepts of Thermodynamics: The Ideal Gas, Review of first and second laws of thermodynamics, PVT behaviour of Pure Substances, Virial Equation of State, Application of the Virial Equations, Cubic Equations of State. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

Module II: 10L

Thermodynamics and its Applications: The Chemical Potential and Phase Equilibria Fugacity and Fugacity Coefficient: for pure species and solution; The Nature of Equilibrium, the Phase Rule, Duhem's Theorem, Simple model's for Vapour/Liquid Equilibrium, Roult's Law, Henry's law, Modified Raoult's Law.

Module III : 10L

Kinetics: Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction,Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions

Module IV: 10L

Applications of Kinetics: Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes.– derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitive.

Textbook :
1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH

Reference books:
1. Richardson, J.F., Peacock, D.G.Coulson & Richardson's Chemical Engineering- Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Levenspiel.O., Chemical Reaction Engineering, Wiley Eastern Ltd.
3. Bailey & Olis,Biochemical Engg. Fudamentals, MGH, 1990
4. Physical Chemistry: Castellan, Narosa Publishing.
5. Physical Chemistry, ;Moore, PHI BT

BT-302: Biochemistry **L-T-P = 3-1-0**

At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: (10L) Introduction to Enzyme & Carbohydrate Metabolism:

Enzymes: Basic concept of enzyme-substrate reaction, Classification and nomenclature, Enzyme active site, Regulation of enzyme activity, allosteric regulation. Generation and utilization of ATP. **Metabolic pathways of carbohydrates and their regulation:** glycolysis, TCA cycle, pentose phosphate pathway, Entner-Doudoroff pathway and Cori cycle. Oxidative phosphorylation**:** electron transport chain, ATP synthesis, regulation of oxidative phosphorylation; gluconeogenesis, glycogen (glycogenolysis and glycogenesis). Photosynthesis**:** Photophosrylation, Calvin cycle. Disorder/ diseases of carbohydrate metabolism.

Module II: (10L) Metabolism of Amino acid, Protein:

Catabolism and Anabolism, Catabolism of amino acids, general metabolism of amino acids. catabolism of Tyrosine, Leucine, Glutamic acid and Arginine Glucogenic amino acids, ketogenic amino acids. urea cycle and its regulation, protein degradation and turnover. Disorder/ diseases of amino acids metabolism.

Module III: (10L) Metabolism of lipid, nucleic acid and vitamin:

Oxidation of Fatty acid: Beta oxidation and omega oxidation of fatty acids – saturated and unsaturated fatty acids –even and odd numbered. Catabolism of phospholipids. Biosynthesis of fatty acids, phospholipids, cholesterol and steroid, Disorder/ diseases of lipid metabolism. **Nucleic acid metabolism:** nucleotide metabolism, purine and pyrimidine degradation, De Novo and Salvage Pathways. Disorder of purines and pyrimidines metabolism. **Metabolism of Vitamins,** Brief description of animal and plant hormones.

Module IV: (10L) Cell Signaling:

Cell signaling and signal transduction pathways: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, second messengers, regulation of signaling pathways, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins.

Textbook:

1. Lehninger's Principles of Biochemistry by Nelson & Cox

Reference books:

1. Molecular Biology of the Cell by Bruce Alberts, 4th ed, Garland Science Publishers, 2002
2. Lubert Stryer, Bio chemistry, Freeman & Co, NY
3. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
4. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

BT-303: Microbiology **L-T-P = 3-1-0**

Module I : 10L

Introduction to Microbiology:

Basic microbiology- Landmark achievements in 20th century: Refutation of abiogenesis: Major contribution of scientists. Cell structure and sub cellular organelles of bacteria– Slime layer, capsule, cell wall, flagella, pili, fimbriae, nucleoid, plasmid and episome (F, R, Ti as example) ribosome, cytoplasmic inclusions (inorganic and organic), endospores. Archibacteria (importance- structure- reproduction), Moulds (importance- structure- reproduction), yeast (structure-reproduction), algae (importance- structure-reproduction). Virology- General classification of virus, (structure, nucleic acid, cultivation of bacteriophage, coliphage), animal viruses plant viruses, TMV). Importance of viruses, life cycle of viruses, lytic cycle (T4) and lysogenic (lambda). Taxonomy- The five kingdom classification, criteria for classification, bacterial phylogeny, numerical approach, new approaches – taxonomic implications of DNA base composition

Module II: 10L

Basic Principles of Microbiology:

Microscopy- Principles and applications, dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM. Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical compounds, anionic and cationic detergents.

Module III

Microbial Growth and Metabolism

Growth of bacteria- Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, The mathematical nature and expression of growth. growth principles of nutrition, influence of environmental factors-pH, temperature, oxygen, Heavy metals and Other compounds. Bacterial metabolism-Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), Entner Duodruffs pathway, bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation– non-symbiotic, symbiotic (definition and examples), basic concept of nif –genes. Mod genes, nitrogenase complex, legheamoglobin.

Module IV

Microbiology of Air, Water and Soil:

Air microbiology- Microorganisms in the air, sampling techniques, air borne pathogens. Microbiology of water- Microbiology of fresh water and wastewater (sewage), Important water borne diseases– cholera, typhoid, (name of pathogen, preventive measures). Outlines of method for detection of microorganisms in drinking water (presumptive, confirmatory and completed tests). Distinction between fecal and non-fecal coliforms. Soil microbiology- Soil microorganisms, different kinds of association between soil microflora, between micro and macro organisms.

Textbook:

1. R.C Dubey and D. K Maheshwari -A Text Book of Microbiology, 3rd ed, S. Chand and Company.
2. C.B Powar and H.F Daginawala- General Microbiology (Vol I & II) 3rd ed, Himalaya Publishing House.

Reference books:

1. Stanier R. –General Microbiology, 5thed, Macmilan Press ltd.
2. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5thed, MGH
3. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill
4. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edns
5. A.H. Rose, Chemical Microbiology, 3rded, Butterworth World Student Reprints

PRACTICAL

CH-381: Basic Environmental Engineering and Elementary Biology Lab

L-T-P = 0-0-3

1. Physical examination of Sewage/Water
    a. Total Solid
    b. Total dissolve solid
    c. Total suspended solid
    d. pH, color and odor
2. Chemical estimation of Swage/Water
    a. Determination of Chlorides
    b. Determination of Hardness of water
    c. Estimation of Chemical oxygen Demand
3. Microbial examination of Swage/Water
    a. Confermation of coliforms
    b. Biological oxygen demand
4. Examination of different stages of cell division using prepared slide (Mitosis and Meiosis)
5. Examination of different bacteria, algae, fungi, plants and animals by microscopic or morphological Examination

CH-382: Chemistry -2 for BT Lab **L-T-P = 0-0-3**

1. Amino Acid Analysis: pH measurements and Buffer Preparation
2. Amino Acid Analysis: Isoelectric Point Determination
3. Determination of N, P, K, organic C from soil smaples
4. Separation of Lipid/sugar: TLC/Paper Chromatography
5. Estimation of cholesterol by Zak's method

6. Estimation of DNA /RNA by chemical method (DNA estimation by diphenyl amine and RNA by orcinol method)

BT-391: Biochemistry Lab **L-T-P = 0-0-3**

1. Spectrophotometry: Verification of Lambert-Beer's law
2. Estimation of sugars: Enzymatic method (GOD method)
3. Separation of amino acids/ sugars/ steroids/ vitamins/ alkaloids/antibiotics - Thin layer chromatography/ Paper chromatography (at least one adopting both methods).
4. Determination of specific activity of an enzyme (α and ß amylase/SDH/alkaline phosphatase)
5. Enzyme Kinetics - (Determination of K_m and V_{max}) of a enzyme
6. Determination of temperature and pH optima of an enzyme
7. Enzyme Inhibition – determining the nature of inhibition
8. Separation of proteins by Polyacrylamide Gel Electrophoresis (PAGE).
9. Chemical estimation of DNA /RNA (by spectroscopy):

BT-392: Microbiology Lab **L-T-P = 0-0-3**

1. Sterilization techniques
2. Media preparation
3. Microscopy and Micrometry
4. Isolation, enumeration and purification of microbes from a given sample
5. Staining Techniques (Simple, Gram staining, spore staining)
6. Biochemical Characterization of Bacteria
   - Oxidation/Fermentation Test
   - Catalase, Oxidase and Urease Tests
   - IMViC test
   - Hydrogen Sulfide Test and Nitrate Reduction Test.
   - Casein and Starch Hydrolysis
7. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
8. Growth Kinetics (Bacterial Growth Curve)

2nd Year - Semester IV
THEORY

M (CS)-401: Numerical Methods **L-T-P = 2-1-0**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. (5)

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. (3)

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. (6)

Numerical solution of Algebraic equation:
Bisection method, Regula-Falsi method, Newton-Raphson method. (4)

Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6)

Text Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

CH-401: Industrial Stoichiometry **L-T-P = 3-1-0**

Module I: 10L

Small units and dimensions:

Buckingham Pi-theorem. Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log-log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.

Module II: 10L

Material balance:

Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification such as continuous filtration, batch mixing, crystallizer, distillation column. Material balance with chemical reaction: Stoichiometry of growth and product formation: growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams.

Module III: 10L

Energy Balance:

General energy balance equation for steady and unsteady state processes,: Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production, Energy-balance equation for cell culture, for fermentation processes.

Module IV: 10L

Combined Material and Energy Balances

Simultaneous material and energy balances, selected industrial process calculations for chemical and bioprocesses.

Textbook:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd ed, John Wiley.

Reference books:

1.Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed.
Prentice Hall,
2. Bhatt & Vora, Stoichiometry , 4th Ed., TM
3. Bioprocess engineering: 2nd edition, Michael L. Shuler, Filkert Kargi

CH-402: Transfer Operation-I **L-T-P = 3-0-0**

Module I: 8L

Basic concepts of Fluid Mechanics:

Dimensional Analysis: Buckingham Pi-theorem, Dimensionless groups, Conversion of equations. Basic equations of Fluid Flow, Hagen Poiseville equation, Bernoulli Equation, Fluid Friction. Friction in flow through packed beds, fundamentals of fluidisation.

Module II: 6L

Flow measurements and machineries:

Flow through pipes and open channels, Orifice and Venturi meters, Pitot Tube, Weirs, Rotameters and other types of meters, Transportation of fluids, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type - peristaltic. Blowers and Compressors (oil-free).

Module III: 6L

Heat transfer:

Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Countercurrent and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Heating and cooling of fluids, Heat transfer equipm ent. Unsteady state heat transfer, Radiation Partial differential equations and its applications: one dimensional heat flow equation and solution; two dimensional heat flow equation and solution.

Module IV: 10L

Mechanical Operations & Transport Phenomena:

Principles of comminution, Types of comminuting equipment, Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Mechanical separation, Screening, Types of screen, Filtration,

Principle, Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal Separations.Similarity of mass, momentum, and energy transfer, Nevier-Stoke's equation, flow analysis using N-S equation for flow down in inclined plane.

Revision: 5L

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference books:

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.
2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann
3. D.Q. Kern, Heat Transfer, MGH
3. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
4. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS
5. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
6. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot: Transport phenomenon,John Wiley & Sons Inc. Asian students Edition.6

BT-401: Molecular Biology **L-T-P = 3-1-0**

At least 45 Hrs/Sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module-I (10L) Introduction to Molecular Biology, Replication & repair:

Introduction: Double Helix model of DNA by Watson and Crick. A, B, Z Forms of DNA; Supercoiling of DNA, Nucleosome bead, Chromatin structure, Central Dogma of molecular biology. **Replication in prokaryotes and eukaryotes:** Mechanism, Model, structure and function of different Enzymes in DNA replication. Initiation, Elongation & Termination of replication; Inhibitors of DNA replication; RNA replication. **DNA Repair in Prokaryotes and Eukaryotes:** Nucleotide excision repair, base excision repair, mismatch repair, photo-reactivation repair, recombination repair and SOS repair. Repair defects and human diseases,

Module-II (10L) Transcription:

Components of transcriptional machinery in prokaryotes and eukaryotes: Structure of mRNA, promoter, RNA polymerases and transcription factors, terminators. **Process of transcription in prokaryotes and eukaryotes:** Initiation, Elongation & Termination of transcription (Rho dependent and independent). **Post transcriptional processing of RNA**: capping, splicing (different types), polyadenylation and RNA editing. mRNA stability. Inhibitors of transcription. Reverse transcription. Ribozyme.

Module-III (10 L) Translation:

Components translational machinery in prokaryotes and eukaryotes: structure and function of ORF, tRNA, rRNA, aminoacyl synthetases, Ribosomes, RBS). **Process of Translation in prokaryote and eukaryote:** Initiation, Elongation & Termination. Concept of genetic code and Wobble hypothesis. Post translational modifications of protein, Protein folding, Protein targeting and degradation, Inhibitors of translation.

Module-IV (10 L) Regulation of Gene Expressions:

Molecular structure of genes and its nomenclature. **Principle of gene regulation:** negative and positive regulation,

inducer, repressor, co-repressor, activators, co-activators, silencers, insulators, enhancers, DNA binding protein-protein interacting domain of gene regulatory protein. **Gene regulation in prokaryote:** concept of operon model, (*lac*, *trp* and *ara* operon), Phage regulatory strategy and antitermination in lambda phage. **Gene regulation in eukaryotes:** DNA looping model, hormonal control of gene expression (steroid and non steroid), regulations at level of translation, riboswitch, gene silencing.

Text books:

1. Molecular Biology of the Gene – by Watson
2. Gene IX by B. Lewin.
3. Essentials of molecular Biology, by Malacinski and Freifelder Jones and Bartlelt Publishers.

Reference Book:

1. Molecular and Cellular Biology- by Stefen Wolfe
2. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley and Sons.
4. The Cell - A molecular approach, by Gm Cooper Asm Press.

BT-402: Industrial Microbiology and Enzyme Technology L-T-P = 3-1-0

Module I: 10L

Commercial Strain Development & Microbial Processes: Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique. Basic idea on fermentation process, submerged, stationary, solid and semi-solid – with their merits and demerits, Outlines of all microbial processes like productions of organic acids, solvent, antibiotic, polysaccharide, enzymes, vitamins, lipids, pigments, aroma, Classical process may be discussed in details: Wine and spirits; Acetone-butanol; Penicillin/Tetracycline/Streptomycin fermentation; Alkaline protease/lipase/amylase; Citric acid; Dextran, xanthan gum.

Module II: 10L

Introduction to Fermentation Technology: Microbial Culture systems; Media for Industria fermentations; Media Optimization; Sterilization of Industrial Media; The development of Inocula for Industrial fermentations; Starter Cultures; Downstream Processing and fermentation economics.

Module III: 10L

Application of Enzyme and Enzyme Technology: Extraction and Purification of Crude Enzyme extracts from plant, animal and microbial sources-some case studies; Brief Enzyme Overview; Classification & Nomenclature;Storage & Handling;Units of Activity;General Characteristics; Environmental Effects on Enzyme Activity; Glycosidic Hydrolases; Cellulases. Pectic Enzymes, Proteolytic Enzymes, Esterases, Lipase, Oxidoreductases, Lipoxygeanase. Stability of enzyme, strain selection, (thermophilic, halophilic, alkalophilic producer strain), Cloning stable enzyme in mesophile, Protein engineering to improve enzyme stability, Enzyme applications – (Industrial, medical and analytical), Reaction environment rebuilding, Enzyme reaction in non-aqueous medium, Synthesis with hydrolase enzymes, Chemical modification of enzyme to improve physico-chemical properties, Immobilization of enzymes, Various techniques

Module IV: 10L

Enzyme Immobilization Technology: Physical and Chemical techniques for enzyme Immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding – examples. Advantages and disadvantages of different

Immobilization techniques. Overview of applications of immobilized enzyme systems, Applications of enzymes in analysis; Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors-Packed- bed, Fluidized-bed Membrane reactors; Bioconversion calculations in free- enzyme CSTRs and immobilized enzyme reactors.

Text books:

1. L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher
2. W. Crueger, Annelise Crueger, Biotechnology: A Textbook of Industrial Microbiology, Sinauer Assoc. Inc
3. Fundamentals of enzymology by Nicolas C. price and Lewis stevens . Oxford University Press
4. Enzymes by Trevor palmer, East west Press 3. Enzyme Technology by Messing

Reference books:

1. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers,New Dehli, India, 1987.
2. Atkinson.B and Marituna.F, Biochemical Engineering and Biotechnology Handbok,The Nature Press, Macmillan Publ. Ltd.4
3. Enzymes : Dixon and Webb.(IRL Press) Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
4. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

PRACTICAL

HU-481: Communication Skill and Report Writing L-T-P = 0-0-3

Cr-2

Guidelines for Course Execution:

Objectives of this Course: This course has been designed:

1. To inculcate a sense of confidence in the students.
2. To help them become good communicators both socially and professionally.
3. To assist them to enhance their power of Technical Communication.

Detailed Course Outlines:

A. Technical Report Writing: 2L+6P

1. Report Types (Organizational / Commercial / Business / Project)
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)

B. Language Laboratory Practice

I. Introductory Lecture to help the students get a clear idea of Technical Communication & the *need of Language Laboratory*

Practice Sessions 2L

2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P

***a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to* get their Listening Skill & Speaking Skill honed**

b) Introducing Role Play & honing over all Communicative Competence

3. Group Discussion Sessions: 2L+6P

a) Teaching Strategies of Group Discussion

b) Introducing Different Models & Topics of Group Discussion

c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure

Interview Sessions: 2L+6P

a) Training students to face Job Interviews confidently and successfully

b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication

4. Presentation: 2L+6P

a) Teaching Presentation as a skill

b) Strategies and Standard Practices of Individual /Group Presentation

c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids

5. Competitive Examination: 2L+2P

a) Making the students aware of Provincial /National/International Competitive Examinations

b) Strategies/Tactics for success in Competitive Examinations

c) SWOT Analysis and its Application in fixing Target

Books – Recommended:

1. Nira Konar: English Language Laboratory: A Comprehensive Manual PHI Learning, 2011

2. D. Sudharani: Advanced Manual for Communication Laboratories & Technical Report Writing

Pearson Education (W.B. edition), 2011

References:

Adrian Duff et. al. (ed.): Cambridge Skills for Fluency

A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)

B) Listening (Levels 1-4 Audio Cassettes/Handbooks)

Cambridge University Press 1998

Mark Hancock: English Pronunciation in Use

4 Audio Cassettes/CD'S OUP 2004

M (CS)-491: Numerical Methods Lab L-T-P = 0-0-2

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

CH-481: Transfer Operation I Lab **L-T-P = 0-0-3**

1. Experiments on Reynold's Apparatus-Determination of flow regime and construction of friction factor against NRe.
2. Experiments on flow measuring device—in closed conduit using (a) Venturimeter, (b) Orifice meter (c) Rotameter.
3. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
4. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
5. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
6. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.
7. To study the characteristics of film-wise / drop-wise condensation.

BT-491: Molecular Biology Lab **L-T-P = 0-0-3**

1. Isolation of Genomic DNA from blood, plant cell and bacteria (any one)
2. Isolation of RNA
3. Isolation of Plasmids
4. Spectroscopic analysis of DNA/RNA
5. Preparation of Agarose Gel
6. Formaldehyde gel electrophoresis of RNA
7. Induced mutation by: (a) Chemical (b) Ultraviolet light
8. Phage Titration

BT-492: Fermentation Technology Lab **L-T-P = 0-0-3**

1. Batch Fermentation and Recovery and Assay of Antibiotics (Penicillin/Streptomycin or any enzyme of the institutions choice)
2. Production of Alcohol (Fermentation and Recovery)
   (i) Using Molasses/ Sugarcane Juice (Batch)
   (ii) Using Immobilized Mo's (Batch and Continuous)
3. Batch Fermentation of Organic Acid
4. Batch and Immobilized Fermentation of Bacterial/Fungal Enzymes (Amylases / Proteases or any enzyme of the institutions choice) (Fermentation, Recovery and Assay).
5. Solid State Fermentation (Moulds/ Fungus).

3rd Year - Semester V

Principles & Practices of Management
HU-511
Contacts: 2L
Credits- 2

Module I: Management **(4 hours)**

Definition, nature, importance, evolution of management thoughts – pre & post scientific era, contributions made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow –covering Time & Motion Study, Hawthrone Experiments; Is management a science or art? Functions of manager, ethics in managing and social responsibility of managers.

Module II: Planning & Control **(4 hours)**

Why Management process starts with planning, steps in planning, planning premises, types of planning, barriers to effective planning, operational plan, strategic planning, Mckinsey's 7's

Approach, SWOT analysis, Controlling- concept, Planning- control relationship, process of control, human response to control, dimensions of control, MBO.

Module III: Decision Making & Organizing **(4 hours)**

Nature, process of decision making, decision making under Certainty and Uncertainty, decision-tree, group-aided decision, brain-storming.

Organizing – concept, nature and process of organizing, authority and responsibility, delegation and empowerment, centralization and decentralization, concept of departmentation.

Module IV: Staffing & Motivation **(3 hours)**

Concept, Manpower planning, Job design, recruitment & selection, training and development, performance appraisal, motivation, motivators and satisfaction, motivating towards organizing objectives, morale building.

Module V: Leadership & Communication **(3 hours)**

Defining leadership and its role, should managers lead, leadership style, leadership development, Leadership behavior. Communication- Process, Bridging gap-using tools of communication, electronic media in Communication.

Module VI: Financial Management **(3 hours)**

Financial functions of management, Financial Planning, Management of Working Capital, Sources of Finance.

Module VII: Marketing Management **(3 hours)**

Functions of Marketing, Product Planning & Development, Marketing Organization, Sales Organization, Sales Promotion, Consumer Behaviour, Marketing Research and Information.

Suggested Text Books & References:

1. Robbins & Caulter, Management, Prentice Hall of India.
2. John R.Schermerhorn, Introduction to Management, Wiley-India Edition.
3. Koontz, Principles of Management, Tata-McGrew Hill.
4. Richard L. Daft, New Era of Management, Cengage Learning.
5. Stoner, Freeman and Gilbert. Jr., Management, Prentice Hall of India.

6. Koontz, Weihrich, Essentials of Management, Tata-McGrew Hill.
7. D.C. Bose, Principles of Management and Administration, Prentice Hall of India.
8. Kiran Nerkar, Vilas Chopde & Kogent Learning Inc, Principles and Practices of Management, Dreamtech Press.
9. Parag Diwan, Management Principles and Practices, Excel Books, New Delhi.
10. Joseph M Putty, Management of Principles and Practices.
11. Richard. L.Daft, Principles of Management, Cengage Learning.

B T - 5 0 1 G e n e t i c s L-T-P = 3-1-0 At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Classical Genetics & its exceptions:

Mendelian inheritance; multiple alleles, pseudoallele, gene interaction, complementation, Codominance, incomplete dominance, linkage, pleiotropy; recombination and chromosome mapping, sex determination; extrachromosomal inheritance, special types of chromosomes; Alterations of chromosomes: euploidy and aneuploidy, deletion, duplication, inversion and translocation their genetic implications; pedigree analysis, lod score for linkage testing, karyotypes, chromosomal abnormalities.

Mod-II: 10L Gene Mutation and Cancer:

Gene Mutation: Induced and spontaneous mutation**,** mutation Types, causes and detection, mutant types. Molecular basis of genetic diseases. Applications of genetic disorders: Cancer Genetics: Genetic rearrangements in progenitor cells, oncogenes; proto-oncogenes; tumour suppressor genes – p53, RB and others, virus-induced cancer, cancer and the cell cycle.

Module III: 10L Microbial Genetics :

Biochemical genetics. Bacterial Genetics: plasmids, transposon; Gene transfer: transformation, transduction, conjugation; recombination and complementation analysis; gene mapping. Viral genetics: genetics of animal virus: polio, HIV and adenovirus, Bacteriophage: genetics of lambda, M13, T4 and T7;

Module IV: 10L Biostatistics, Population Genetics:

Biostatistics: Mean, median; mode, standard deviation, variance, discrete and continuous probability distributions, Poisson, normal and binomial distributions, mathematical expectancy; Correlation and regression analysis, T test, chi-square analysis. Population genetics: Hardy-Weinberg equilibrium, changes of gene frequency, continuous variation; extensions of H-W equilibrium. Polygenic inheritance, heritability and its measurements, QTL mapping.

Textbook:

1. Concepts of Genetics, 7th edition, (Low Price edition) M.R. Cummings, A.W. Klug. Pub: Pearson Education. Cengage Learning India (P) Limited

2. M.W.Strickberger: Genetics, Pearson

Reference Books:

1. Introduction to Genetic Analysis, 8th edition, Anthony J. F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, and William M. Gelbart. Pub: W.H. Freeman & Co.

2. Principles of Genetics, 5th edition. D. Peter Snustad, Arthur J. Simmons. Pub: John Wiley & Sons.

3. iGenetics: a Conceptual Approach, 3rd edition, Peter J. Russell. Pub: WH Freeman & Co.

4. Microbial Genetics, 2nd edition, Stanley R. Maloy, John E. Cronan, David Freifelder. Pub: Jones and Bartlett Publisher Inc.

5. Genetics: Principles and Analysis, 4th edition. D.L. Hartl, D.W. Jones. Pub: Jones and Barlett Publishers

6. Introduction to Biostatistics, 2nd edition, Pranab Kumar Banerjee. Pub: S. Chand & Co.

7. Genetics, 9th revised multicolor edition. P.S. Verma & V.K. Agarwal. Pub: S. Chand & Co.

8. Freifelder`s Essentials of Molecular Biology 4th Edn. G.M. Malacinski , Narosa pub

9.Statistical Methods: N.G. Das.

BT-502: Bioinformatics L-T-P = 3-1-0 At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module 1:

Definition and application bioinformatics to biological research and a general view about application relating biological research. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed;. A brief introduction of gene prediction: Prediction of ORF, Promoter.

Module 2:

Sequence analysis: Introduction to sequence analysis, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Needleman and Wunsch algorithm, Smith-Waterman, BLAST, FASTA. Substitution Matrix :PAM and BLOSUM.

Module 3: Perl programming with bioinformatics application , Bio-perl. Introduction to the idea about phylogenetics analysis through multiple sequence alignment: CLUSTALW.

Module 4:

Protein Secondary and tertiary structure prediction : Chou Fasman method, Hidden markov model and neural network, Homology Modelling, Motif identification- Pfam, Prosite. Structure visualization methods (eg: RASMOL, CHIME) Introduction to energy minimization ,QSAR and their relation in drug design.

Textbook:

1. Xiong.J, Essential Bioinformatics, Cambridge University Press
2. Ghosh and Mallick, Bioinformatics-Principles and applications Oxford University Press.
3. James Tisdall, Beginning Perl for Bioinformatics, SPD

Reference books:

1. Cynthia Gibas and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
2. Atwood, Introduction to Bioinformatics, Person Education
3 Smith, D.W, Biocomputing : informatics and Genome Project,.,1994, Academic Press, NY.
4. Baxevanis, A.D, Quellette. B.F.F, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, , John Wiely & Sons.
5. Andrew Leach, Molecular Modelling: Principles and Applications,Pearson Education.

CHE 515 Transfer Operations– II L-T-P = 3-1 At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L

Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Interphase Mass Transfer, Gas Absorption, countercurrent multistage operation, Packed Tower.

Module II: 10L Distillation:

Vapour-liquid equilibrium, Rayleigh's Equation, Flash and Differential distillation, continuous rectification, McCabe-Thiele Method, bubble cap and sieve distillation column.

Module III: 10L Extraction, Drying and Crystallization:

Liquid–liquid equilibrium. Liquid extraction, Stage wise contact; Liquid-solid equilibria, Leaching; Batch drying and mechanism of batch drying, Principle and operation of a spray drier, Preliminary idea of Crystallization,

Module IV: 10L Advanced Separation Processes:
Dialysis, ultrafiltration, reverse osmosis, pervaporation, electrodialysis and membrane separation.
Revision: 5L

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference book:
1. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
2. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
3. Treybal, R.E., Mass-Transfer Operations, MGH
4. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

CS 515: Data Structure and Algorithm L-T-P = 3-1-0 At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L
Linear Data Structures: Sequential representations, Arrays and Lists, Stacks, Queues and D- queues, String and their applications. Link Representation: Linearly linked lists, Circularly linked lists, Doubly linked lists and applications.

Module II: 10L
Algorithms for creating and manipulating different linear data structures. Non-linear Data Structure: Trees – Binary Trees, Binary Search Trees, Insertion and Deletion algorithms , Height-balanced and Weight-balanced trees , B–trees .

Module III: 10L
Graph Representations, Breadth first search (BFS) and Depth first search (DFS). Graph Theoretic Algorithms - Incidence Matrix, Adjacency Matrix, Algorithms for Minimal Spanning Tree (Prim's and Kruskal's Algorithm).

Module IV: 10L
Sorting and Searching Algorithms: Bubble sort, Insertion sort, Quick sort , Merge sort. File structures: Record & Table Structures, Sequential and Direct access, Indexed Files, Inverted Files, Hashed Files.
Revision: 5L

Textbook:

1. Aho Alfred V, Hopperoft John E., Ullman Jeffrey D. , "Data Structures and algorithms", Pearson

Reference books:

1. Horowitz Ellis & Sartaj Sahani , "Fundamentals of Data Structures" , Galgotria Pub.
2. Tenenbaum A. S., "Data Structures using C",Pearson
3. N. Deo, Graph Theory -, PHI.

BT591: Genetics Lab L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

1. Preparation of different stages of Mitosis and Meiosis
2. Karyotype analysis and Ideogram preparation of plant/animal/human chromosomes.
3. Estimation of mitotix index
4. Study of chromosomal aberrations in mouse bone marrow cell and plant cells.
5. Barr body preparation from buccal smear.
6. Pedigree analysis
7. Finding statistical significance of a given data using 't test'

BT 592: Bio-informatics Lab L-T-P 0-0-3 (2 credits, contact hrs, 0-0-3)

1. Handling of Biological databases eg: NCBI, EMBL, PDB,
2. Pair wise sequence alignment (EMBOSS and BLAST) and multiple sequence alignment (CLUSTAL W) and phylogenetic analysis (CLUSTAL W)
3. Prokaryotic gene prediction
4. Prediction of secondary and tertiary structure of proteins ; structure viewer and analysis.
5. Basic introduction to molecular modeling,
6. Perl programming,

CHE- 584- Transfer operation Lab II L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

1. To verify Rayleigh's equation.
2. To draw the vapour-liquid equilibrium diagram from Othmer Still.
3. To study the performance of a Rectification Column.
4. To determine the gas-liquid mass transfer coefficient (Wetted Wall column or Stirred Cell).
5. To study the drying characteristic curves under constant drying condition in rotary and tray dyers.

CS 584: Data Structure Lab L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

Implementation of Array Operations: (using C/C++ languages)

Stacks and Queues: Adding, Deleting elements, Circular Queue: Adding and Deleting elements, Merging Problem.

Implementation of linked lists: Inserting, Deleting , Inverting a Linked List. Sorting and Searching Algorithms,

Prim's, Kruskal's and Dijkstra's Algorithm.

3rd Year - Semester V

Production & Operations Management
HU-611
Contacts: 2L
Credits- 2

Module	Syllabus	Contact Hrs

1.	**Introduction** : System concept of production; Product life cycle; Types and characteristics of production system; Productivity; Process and product focused organization structures;	3
2.	Management decisions – strategic, tactical and operational	4
3.	**Forecasting** : Patterns of a time series – trend , cyclical, seasonal and irregular; Forecasting techniques : moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component.	4
4.	**Materials Management and Inventory Control** : Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned	3
5.	shortages, Quantity discounts for EOQ model; ABC analysis; Just-in-time inventory management.	3
6.	**Materials Requirement Planning** : MRP concept – bill of materials (BOM), master production schedule; MRP calculations.	3
7.	**Machine Scheduling** : Concept of Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, Earliest due date (EDD) rule to minimize maximum lateness, Total tardiness minimizing model; Minimizing makespan with identical parallel machines; Johnson's rule for 2 and 3 machines scheduling. **Project Scheduling** : Activity analysis; Network construction; critical path method (CPM); Crashing of project network. **Quality Assurance** : Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : x-chart and R-chart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.	4

Books Recommended :

1. Buffa and Sarin, Modern Production/Operations Management, John Wiley & Sons.
2. R. Panneerselvam, Production and Operations Management, PHI.
3. Russell & Taylor, Operations Management, PHI.
4. Adam and Ebert, Production and Operations Management, PHI.
5. Production & Operations Management by Starr, Cenage Learning India.

BT – 601: Recombinant DNA technology: Contracts: L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Tools of Recombinant DNA technolgy:

Restriction & modification enzymes (Restriction enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase); **Cloning Vectors:** plasmid, M13 vectors, cosmids, Phagemids,YAC, BAC and MAC; Expression vectors**:** pET vectors, Baculovirus vectors.

Mod-II: 10L Techniques Recombinant DNA technology :

DNA labelling (radioactive and non radioactive method); DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, shotgun sequencing method)'; Protein sequencing; RNA sequencing; Southern and northern and western blotting; In-situ hybridization; Site-directed mutagenesis; DNA fingerprinting (RAPD; RFLP, AFLP).

Mod-III: Gene Cloning Methods

Isolation of DNA, mRNA and total RNA; Polymerase chain reactions (PCR) and modified PCR. Genomic and cDNA libraryies; Gene isolation; Gene cloning; screening & Expression of cloned gene; Transposons and gene targeting;

Module IV: 10L Application of rDNA technology

Gene transfer technologies, production of insulin, human growth factor; gene therapy (antisense and ribozyme technology), Human genome project and its application. Large scale Gene expression analysis (Microarray for DNA and protein). strategies for genome sequencing. Biosafety.
Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials. Revision: 4L (1 for each module)

Textbook:

1.Old and Primrose, Principles of Gene Manipulation, 3rd Ed, Blackwell ScientificPublishers.2
2. Genetic Engineering by S. Rastogi and N. Pathak, Oxford Univ. Pub.
3. Recombinant DNA Technology: Setubal: Introduction to computational Molecular Biology. Cengage Learning India (P) Limited

Reference books:

1). D.M. Glover, Genetic Engineering, Cloning DNA, Chapman and Hall, New York, 1980
2. B. R. Glick and J.J. Pasternak ; Molecular Biotecnology: Principles and Applications of Recombinant DNA, ASM press
3.Watson, J.D., Gilman, M., Witkowski, J., Zoller, M. - Recombinant DNA, Scientific American Books, New York, 1992.
4. H.K. Das, Text Book of Biotechnology, 1st ed, 2004, Wiley Publishers
5.Brown, T.A., Genetics a Molecular Approach, 4th Ed. Chapman and Hall, 1992
6. D. M. Glover and B.D. Hames; DNA cloning: A Practical Approach, IRL Press.
7. Brown TA, Genomes, 3rd ed. Garland Science 2006

BT-602: Immunology Contracts: L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module 1: 10L Introduction to Immunology:

The origin of Immunology: History and evolution of immune system; Innate immunity; Acquired immunity; Humoral and cell-mediated immunity; Passive transfer of immunity; Primary and secondary lymphoid organs; Structure and function of Antigen; Concept of Epitope, B cell and T cell: Biogenesis or Maturation; Macrophage and other Antigen Presenting Cells (APCs).

Module II: 10L Molecular basis of Immunology:

Structure and function of Antibody; Concept of Isotype, Allotype and Idiotype; Molecular basis of antibody diversity: DNA rearrangements; variations arising out of V,D,J joining; somatic hypermutation; Class switching; Primary and secondary immune response; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction, Basic concepts of Immunodiffusion, RIA and ELISA.

Module III: 10L Major Histocompatibility Complex (MHC):

Antigen processing and presentation; synthesis of antibody and secretion; HLA; laws of graft rejection; graft versus host reaction; Development of Inbred mouse strain; Blood group classification and Rh factor, Cytokines and other co-stimulatory molecules.

Module IV: 10L Immune response and tolerance:

Regulation of immune response; Immune tolerance; T cell anergy and T cell elimination; Hypersensitivity; Autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; AIDS and immunodeficiency; Tumour immunology; vaccines.
Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials. Revision: 4L (1 for each module)

Text Book:

1. Roitt, Immunology, 6th ed 2001, Mosby Publications.
2. Immunology and Immune Technology by A. Chaktraborty, Oxford Univ. Pub.
3. Immunology: An Introduction. Tizard Cengage Learning India (P) Limited

Reference books:

1. Essential Immunology, Roitt, I.M., 9th Ed. (1997), Blackwell Scientific, Oxford, UK
2. Immunology, Kuby, J. 3rd Ed. (1997), Freeman, W.H,Oxford,UK
3. Weir, Immunology, 8th ed, W.B. Saunders& Co.
4. K.A. Abbas, Immunology, 4th ed, W.B. Saunders& Co.

BT-603 Plant Biotechnology L-T-P = 3-1-0

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L: Plant tissue culture – theory and methods:

Brief history of Plant tissue culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, mode of action of auxin and cytokinin. Micropropagation , somaclonal variation and haploid culture, cell suspension culture.

Module II: 10L: Plant tissue culture – product and recovery:

Primary and secondary metabolic products (phytochemicals) of plant cells, Basic strategies and factors for secondary metabolite production, Immobilisation and biotransformation for product development and selection of cell culture (only plant tissue culture products).

Module III: 10L Plant genomes:

Structure and organisation of plant genome, regulation of plant genome expression, transcriptional, translational and post transcriptional regulation of plant genome, plant growth regulator. Transposons, chloroplast and mitochondrial genome. (Arabidopsis should be taken as the model for study of plant genome).

Module IV: 10L Plant tissue culture –Plant genetic engineering:

Direct transformation by electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector and other plant based vectors. Theory and techniques for the development of transgenic plants, conferring resistance to herbicide (Glyphosate, Basta), pesticide (Bt gene), plant pathogens PR-Proteins. Plant engineering towards development of enriched food products – Golden rice.

Textbooks:

1. Slater.A., Nigel W.S,Flower. R.Mark , Plant Biotechnology: The Genetic Manipulation of Plants, 2009, Oxford Univesity Press.
2. Ramawat.K.G. ,Goyal, S. Comprehensive Biotechnology 2009, S.Chand & Company, New Delhi

Reference books:

1. Buchaman, Gursam, Jones, Biochemistry and Molecular Biology of Plants, 1ed, 2000, L.K.International.
2 Bhozwani and Razdan –PlantTissue Culture: Theory and Practice 1996 Elsevier
4. Butterworth & Heineman, Invitro Cultivation of Plant Cells, Biotol Series.
5. H.E Street(ed): Tissue culture and Plant science, Academic press, London, 1974
6. Gamborg O.L.,.Phillips G.C, Plant Cell, Tissue and Organ Culture, Narosa Publishing House
7. Das.H.K. Text Book of Biotechnology-First Edition 2004,Wiley Dreamtech.

BT 604A: Bioseparation Technology Contracts: L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Basic Concepts

Basic concepts of Bio-separation Technology, Separation characteristics of proteins and enzymes – size, stability, properties; purification methodologies Characteristics of bio- products; Flocculation and conditioning of broth, overview of reaction processes involved in separation, numerical examples illustrating the process. Mechanical separation processes; Filtration at constant pressure and at constant rate; empirical equations for batch and continuous filtration, centrifugal and cross-flow filtration, Centrifugation: basic principles, design characteristics; ultracentrifuges:: principles and applications.

Module II: 10L Techniques Involved in Separation Processes

Foam-fractionation; Solvent extraction of bio-processes, aqueous two-phase extraction, adsorption-desorption process; Salt precipitation; Chromatographic separation based on size, charge hydrophobic interactions and metal ion affinity. HPLC, Affinity chromatography, inhibitors: their preparation and uses, method of linkages, Electrophoresis SDS-PAGE (Polyacrylamide Gel), horizontal and vertical type, methods, case studies.

Module III: 10L Membrane based separation processes

Micro-filtration, Reverse osmosis, Ultrafiltration and affinity ultrafiltration, concentration polarization, rejection, flux expression, membrane modules, dead-ended and cross-flow mode, material balances and numerical problems, biological applications.

Module IV: 10L Industrial Applications

Industrial aspects of separation of biomolecules, Material balances, mathematical analysis and modeling, relative advantages and disadvantages of separation methods, Case studies.

Textbook :

1. Schuler & Kargi, Bio-process Engg. PHI

Reference books:

1. Bailey & Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
2. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
3. Muni Cheryan, Handbook of Ultrafiltration
4. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill
5. Ho, W.S.W. & K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y. (1992)

BT–604:B MolecularModeling and Drug Designing L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L

Introduction to molecular Simulation Techniques-Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples- Ising Lattice, Gibbs Ensemble Monte Carlo Simulations. Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

Module II: 10L

Molecular mechanics, Energy minimization, intra molecular interactions, Physicochemical parameters in drug design- Ionization constants, chelation, solubility and partition Co- efficient. Over view of Molecular Descriptors.

Module III: 10L

Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches- Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors,

Module IV: 10L

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools, scoring and Docking mode, QSAR principles and Methods in drug designing. Current research in drug designing- a case study.

Textbooks:

1. ARLeach-Molecular Modelling, .Principles and application 2nd edition–Prentice Hall.
2. Krogsgaard,L-Text Book of Drug Design and Discovery-2002 Taylor and Francis,London

Reference books:

1. G.Walsh-Biopharmaceuticals-Biochemistry and Biotechnology-2003, Wiley
2. Scolnick.J.(2001) Drug Discovery and Design .Academic Press, London
3. N. R. Cohen, Editor. Guidebook on Molecular Modeling in Drug Design. Academic Press, San Diego, 1996.

BT 604C: Biophysics of Macromolecules L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module1: 10L

Introduction to biophysics, Strong and weak interactions in biomolecules, dielectric properties of biomolecules, electronic properties of biomolecules – condctivity, photoconductivity and piezoelectric effect, conformation and configuration of biomolecules.

Module 2: 10L

Conformation of proteins and enzymes, effect of amino acids on the structure of proteins, energy status of a protein molecule, helix coil transformation of proteins, structure-function relations of enzymes, cooperative properties of enzymes, dynamics of protein folding.

Module 3: 10L

Conformation of nucleic acids, helix coil transformation, thermodynamics of DNA denaturation, Changes in nucleic acid structures during biochemical processes

Module 4: 10L- Advanced discussion

Methods for study of biomolecule structure: X-ray diffraction and X-ray crystallography, optical, UV/visible, IR luminescence, fluorescence and circular dichroism spectroscopy, Nuclear magnetic resonance spectroscopy and electron microscopy (SEM and TEM)

Textbook:

1. Biophysical Chemistry Vol 2; Cantor & Schimmel, Oxford University Press

References books:

1. Physical Biochemistry: David Friefelder, 5th Ed, PHI
2. Physical Biochemistry: Kensal E van Holde. PHI
3. Practical Biochemistry Principles and techniques: Editor Wilson and Walker, Cambridge University Press
4. Proteins: Structure and Function: David Whitford: John Wiley &Sons

BT – 603D Biosensors and Diagnostics L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module- I 7 L Introduction :

Sensor architecture and Classification; Medically significant measurands, functional specifications of medical sensors; Sensor characteristics: linearity, repeatability, hysteresis, Overview of Biosensors, Fundamental elements of biosensor devices, Immobilization key to biosensor construction. Redox mediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals.

Module- II: 8L Different types of Biosensor:

Electrochemical Biosensors : Electrochemical principles, Amperometric biosensors and charge transfer pathways in enzymes, Glucose biosensors, Engineering electrochemical biosensors. Optical Biosensors: Optics for biosensors, Attenuated total reflection systems. Mass and Acoustic Biosensors: Saubrey formulation, Acoustic sensor formats, Quartz crystal microblalance. Immunosensor.

Module- III 7L: Modern Biosensors

Variations on the biological biochemical component, Bioaffinity principles, whole cell biosensors. **Lab-on-chip technologies:** Microfluidic interfaces for biosensors, DNA and protein microarrays, Microfabricated PCR technology. Overview on Nanobiosensor, Fiber Optic Biosensors, Nanobarcodes.

Module- IV 8L: Diagnostics for the real world:

Communication and tracking in health monitoring, Detection in resource limited settings. Applications and uses of biosensors, Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring, Gene Expression analysis.

Text books:

1. Biosensors : Tran Minh Canh, Chapman & Hall

2. Biosensors: Oxford University Press, USA; 2 edition, 2004

Reference books:

2. Turner, A.P.F, Karube. I.,and Wilson, G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.

3. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

4. Handbook of Biosensors and Electronic Noses: Medicine, Food and the Environment: CRC-Press; 1 edition;1996

5. Steven S. Saliterman, Fundamentals of BioMEMS and Medical Microdevices ,SPIE Press Monograph Vol. PM153, 2006

6. D. L. Wise, Biosensors: Theory and Applications, CRC Press,1993

BT 604E: Bio-fertilizers and Bio-pesticides L-T-P = 3-0-0 Credits- 3

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0

Module I Lectures -12

Definition of Bio-fertilizers; composition and nutritional role based classification of different bio-fertilzers viz., Composts – vermicompost and nitrogen fixers. Basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production. Role of *Azola*, *Tichoderma Cianobacteria*, *Trichogramma* in bio-fertilization. Importance of Bio-fertilizer use in agriculture. Knowledge of bacterial and fungal suspensions as inocula and their priparations.

Module II Lectures- 16

Basic outline of processes, characteristics and significance of Biological nitrogen fixation (BNF) and Phosphate solubilizing bacteria/ micro organisms(PSB & PSM) functioning. Outline of biological nitrogen fixation from

biochemical and biological points of view with special reference to different enzymes and other key role players. Biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* sp. with legume plants and others.

Module III **Lectures- 12**

Biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* through root nodulation process and nitrogen fixation by it. Brief concept of nitrogen fixing genes (nif genes) --- their organization and role in the different steps of biological nitrogen fixation. Rhizosphere engineering.

Module IV **Lectures - 08**

Definition and importance of biological pests and bio-pesticides in agriculture. Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM) . Advantages of bio-pesticides over chemical pesticides and developing them . Types of Bio-pesticides with special reference to protein with anti-pest activity; the Bt gene from *Bacillus thuringenensis* and its proteins as biopesticide

Textbook

1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer
2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press
3.Sushil K Khetan, Microbial Pest Control, Marcel Dekker
4. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

CS 615: Database Management System & Computer Networking

L-T-P = 3-0-0 **Credit-3**

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Introduction:

Database System Concepts & Architecture, Data Models, Scheme and Instances , Data Independence, Database Languages, Database Manager, Database Administrator, Database Users, E/R diagram, Relational Data model and Languages : Relational Data Model Concepts, SQL Data Definitions / Queries and Updates in SQL.

Module II: 10L

Example of DBMS ORACLE : Basic Architecture, Data Definitions, Data Manipulation, DBA Functions, SQL, PL SQL, Concurrent operations on the Database : Basic Concepts, A Simple Transaction Model, A Model with Read and Write only.

Module III: 10L

Computer Networking: LAN/MAN/WAN, OSI 7 layer Model, Communication Techniques, TCP/IP Protocol Stacks.

Module IV: 10L

Inter Networking, WWW, URLs, Search Engines, Electronic Mails, Distributed System, Distributed Database System Concepts, Application: Genome Data Management.

Revision : 5L Textbooks:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts, 4th ed, Mc.Graw Hill, Computer Science Series.

Reference books:

1. Elmasri Ramez and Novathe Shamkant,"Fundamentals of Database Systems", Pearson.
2. Ramakrishnan: Database Management System, McGraw-Hill
3. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman Publishers.

4. Jain: Advanced Database Management System, CyberTech
5. Date C. J., "Introduction to Database Management", Vol. I, II, IIIPearson.
6. Ullman J. D., "Principles of Database Systems", Galgottia Publication
7. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
8. Ramez Elmasri, Shamkant B.Navathe "Fundamentals of Database Systems", Pearson
9. Arun K.Majumdar, Pritimay Bhattacharya "Database Management Systems", Tata McGraw Hill

BT-691: Recombinant DNA DNA Technology Lab: L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

Any 5 experiments from the following list:

1. Restriction enzyme digestion of plasmid DNA or lambda DNA
2. Gel purification of RE digested DNA
3. Ligation of DNA fragments with cloning vector pUC18 or pBR322.
3. Preparation of competent cells and Transformation into *E.coli* with recombinant vector.
4. Isolation of recombinants and confirmation of insert DNA in vector.
5. Primer design for PCR and amplification of DNA by PCR.
6. Southern Hybridisation (Demonstration only).

BT – 692: Immunology lab L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

1) Staining of Blood film
2) Blood grouping.
3) Preparation of O and H antigen
4) Quantitative VIDAL test
5) Immunodiffusion in Agar gel
6) ELISA- qualitative
7) Western blot technique.

BT-693: Plant Biotechnology Lab L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

1) Explant selection sterilization and inoculation
2) Various media preparations: MS, B5.
3) Callus and cell suspension culture; induction and growth parameters
4) Chromosomal variability in callus culture
5) Plant regeneration from embryo, meristem and callus culture.
6) Androgenesis: Anther and pollen culture.
7) Somatic embryogenesis-study of different stages of cells

BT-694: Seminar: L-T-P = 0-0-1 (1 credits, contact hrs, 0-0-1)

1. Seminar by invited speaker
2. Student will review of any field of biotechnology and finally they presentation the review by PPT.

CS 684: Database & Computer Networking Lab L-T-P = 0-0-3 (2 credits, contact hrs, 0-0-3)

Familiarization with ORACLE Package, Table design, creation & manipulation with SQL. Sharing resources in a LAN, Internet Connection, Web – browsing, Search Engines, Downloading.

Reference book:

1. Oracle 9i Complete Reference – Oracle Press

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech in BT upto 4th Yearfor the students who were admitted in Academic Session 2010-2011)

Proposed

7th Semester

BT-701: Bioreactor Design & Analysis

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P= 3-0-0 **At least 40 hrs/sem**

Module I: 10L Basic Principles:

Recapitulation - Principles of kinetics for chemical and biochemical reactions. Fundamentals of homogeneous reactions for batch, plug flow, semi-batch, stirred tank/ mixed reactors.

Module II: (10L) Reactor Design:

Types of reactors – batch, plug low reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor bubble column, air lift fermenter etc.

Module III: (10L) Analysis of Non-ideal Reactor Analysis:

Concept of ideal and non-ideal reactor; residence time distribution; models of non-ideal reactors – plug flow reactor for microbial processes; Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fluidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors.

Module IV: (10L) Unconventional bioreactors:

Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture. Advanced Concepts: Scale up concepts, Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells.

Textbook:

1 Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books :

1. Bailey & Olis, Biochemical Engg. Fudamentals, MGH, 1990
2. Atkinson, B., Biological Reactors, Pion Ltd., London,1974
3. "Bioreactors in Biotechnology", Ellis Horwood series, 1991. A. H. SCRAGG

BT-702: Animal Cell Culture & Animal Biotechnology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P= 3-0-0 **At least 40 hrs/sem**

Module I: 10L Animal cell culture and its application:

History of animal cell culture and development, Development of primary culture, Development of cell line by enzymatic disaggregation, Culture media and growth conditions. Cell type and characterization, origin of animal cell line, Differentiation of cancerous cells and role of protooncogenes; cryopreservation; Common cell culture contaminants. Marker gene characterization, Cell cloning and selection; Transfection and transformation of cells. Application of animal cell culture in: Cytotoxicity and viability assays; production of human and animal viral vaccines and pharmaceutical proteins. Stem cell: types, properties and their applications in animal cloning, therapeutics.

Module II: 10L Growth and scale up of animal cell:

Animal cell growth characteristics and kinetics; Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Micro-carrier

attached growth; Cell culture in continuous, perfusion and hollow fibre reactor; Microencapsulation; Growth monitoring; Mass transfer in mammalian cell culture.

Module III: 10L Animal Biotechnology
Animal breeds; Embryo transfer: Artificial insemination, Superovulation, Embryo transfer, In vitro fertilization-Pregnancy diagnosis-Sexing of embryos, Embryo splitting; Cryopreservation of embryo; Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; transgenic animals and stem Cells; Transgenesis and Xenotransplants, Transgenic fish; Animal as bioreactors.

Module IV: 10L Application of Animal Biotechnology:
Organ culture technology; Tissue engineering and its application –production of complete organ - kidney – eyes - heart – brain; Immune system in health and disease, tissue and organ transplant, Vaccinology, Regenerative medicine. Biotechnology in animal production**:** Manipulation of Growth hormone -somatotropic hormone-Thyroid hormone; Probiotics as growth promoters-Ideal characteristics of probiotics, Mode of action-uses of probiotics-Manipulation of lactation –Lactogenesis galactopoiesis- Manipulation of wool growth-Manipulation of rumen microbial digestive system.

Textbook: 1.Davis.J.M Basic Cell Culture Second Edition, Oxford University Press. (First Indian Edition, 2005)
1. Animal cell culture by R.I. Freshney
2. Animal Biotechnology by P.Ramadas
3. In vitro cultivation of Animal cells by Dr.C.K.Leach, Butterworth and Heinnmamm Ltd.1994.

Reference books :
1. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (Eds.), Concepts in Biotechnology, University Press, 1996
2.Das.H.K. Text Book of Biotechnology, First Edition 2004,Wiley Dreamtech.
3. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell, 2000
4. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
5. I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International, 2003.
6. Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press, 1997.
7. Embryonic Stem cells by Kursad and Turksen. 2002.Humana Press.
8. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research, 2002.National Academic press.

BT-703: (10L) Food Biotechnology
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P= 3-0-0 **At least 40 hrs/sem**

Module-I: (10L) Preservation Technology
Spoilage of food – Food poisoning – Microbiology of water, milk, meat, vegetables –Preservation of food by canning, dehydration, irradiation, sterilization etc. Role of lactic acid in preservation in sauerkraut.

Module-II:(10L) Food Production Technology
Fermented and semi-fermented food – Production of single cell protein – Yeast, mushroom – SCP for cattle feed . Genetically modified crop, safety aspects of genetically modified crops.

Module-III: (10L) Technology for Improved Process

Enzymes in bakery and cereal products, Enzymes in fruit juice production, Enzymes in fat /oil production. Enzymes in cheese making and beverage production, Utilization of food waste.

Module-IV: (10L) Analysis of major food ingredients

Analysis of preservative, natural and synthetic- Food colour – Food flavour enhancing agents. Chemical safety measurement – Heavy metal, fungal toxins, bacterial toxins, herbicide, Pesticide. detection, Quality control tests explained in brief.

Textbook:

1. Jay, Modern Food Microbiology, CBS Publishers, 1987

References books:

1. Frazier, Food Microbiology
2. G. Reed, Prescott and Dunn's Microbiology, CBS Publishers, 1987
3. Desrosier, Technology of food preservation, CBS Publisher

BT-704A: Pollution Control & Environmental Biotechnology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I: (10L) Air Pollution Control Methods and Equipment

Primary and secondary air pollutants, Effects of air pollutants on health, Air Pollution laws - EPA & US clean air act and Standards, sampling, basic ideas of air pollution control equipments, Bag Filter, Electrostatic Precipitators, cyclone separators, Wet-scrubbers, Bio- scrubbers, Electrostatic precipitators, High volume sampler, RSPM Sampler, Control of specific gaseous pollutants, Numerical Problems of the control equipments.

Module II: (10L) Water Pollution: Sampling & Analysis

Water pollution; Sources -- Municipal Sewer and Industrial Wastewater and classification of pollutants, B.O.D, C.O.D, D.O, S.S., MLSS and MLVSS, T.D.S, Oil and grease, Metals, Nitrogen and Chloride, Water pollution Laws - EPA & US clean air act and Standards, Sampling methods; Estimation methods, Bacteriological measurements, Numerical Problems on parameters and their determination methods.

Module III: (10L) Wastewater Treatment Processes

Overview of treatment principles: Primary, Secondary, Tertiary. Theory of aeration, Principles, operation and performance evaluation of sewage and wastewater treatment processes: Activated Sludge process, Extended Aeration, Trickling Filter, Mechanically aerated lagoons, Concepts of Waste stabilization ponds, Aquatic plant systems, Upflow anaerobic sludge blanket(UASB) .Common effluent treatment plant-case studies. Membrane based wastewater treatment processes – case studies. Ranking of wastewater treatment processes. Numerical problems on parameters and their determination methods.

Module IV: (10L) Environmental Biotechnology: Specialized aspects

Oil pollution – treatment with micro-organisms, Bioremediation—recovery of metals from waste water and sludge, Preliminary ideas of xenobiotics, degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, Persistent Organic Pollutants (POP), Anaerobic and aerobic composting, Bio-degradation of plastics, Vermiculture, Concept of Biodiversity, Diversity indices.

Textbook:

1. S. P. Mahajan, Pollution Control in Industries, TMG

Reference books:

1.Omasa,Air pollution & plant biotechnology,Springer

2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 4th ed., TMG

3.Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999

4.Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH

5.Sincero & Sincero, Environmental engineering.

BT-704B: Modeling & Simulation of Bioprocesses

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I: 10L

Approach to modeling, Unstructured and structured modeling, Deterministic and stochastic models, Segregated and unsegregated models, Shu's segregated models for Lactic acid fermentation.

Module II:10L

Structured kinetic models: Compartmental models (two and three), Product formation, Unstructured and structured models, Genetically structured models.

Module III: 10L

Stochastic model for thermal sterilization of the medium, Modelling for activated sludge process, Model for anaerobic digestion, Models for lactic acid fermentation and antibiotic production.

Module IV: 10L

Process simulation techniques, Equation oriented approach, Equation oriented simulators SPEED UP, ASCEND, FLOWSIM, QUASILIN, DYNSIM), simulation programs based on Euler's methods, Newton – Raphsen methods, Runga – Kutta methods, Simulation of biochemical system models.

TextBook:

1. J.E. Bailey and D.F. Ollis, Biochemical Engg Fundamentals, 1986, McGraw Hill Book Company

Reference books:

1) G. Francis, Modelling and Simulation

2) A. Haerder and J. A. Roels " Application of simple structured I Bioengineering, and P55 in Advances In Biochemical engineering Vol21, A. Fiechts (ed) Spring –Verlag , Berlin, 1982.

BT-704C: Biomaterials

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I

Definition of biomaterials – biologically derived materials or materials compatible with biology. Common biomaterials: some proteins, many carbohydrates and some specialized polymers. Collagen (protein in bone and

connective tissues): Structure production and its use. Fibroin (protein in silk): Production a and its use. Production of these proteins by conventional cloning methods.

Module II:

Carbohydrates: Modified carbohydrates actin gas lubricants for biomedical applications; Polydextrose made from bacteria; Carbohydrates modified from enzymes; artificial wood.

ModuleIII:

Biopolymers: Synthesis from a simple biological monomer (eg hyaluronate polymers); Dextrans (used in chromatography columns); Rubberllike materials produced by bacteria and fungi (Polyhydroxybutyrate PHB), Polycaprolactone(PCL); Production of a copolymer of PHB and PHV(polyhydrovaleric acid), sold as Biopol by fermentation on Alcaligenes eutrophus; Biodegradable polymers

Module IV:

Industrial biopolymers: Production of polyphenol resins by the enzyme soybean peroxidase; Evaluation of the properties of biopolymers to make good biomaterials; Tensile strength(both elasticity and breaking strength); Hydration, visco – elastic properties; viscosity.

References:

1.Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2nd Edition, 2001

2. Doi Y, Microbial Polyesters, VCH Weinheim, 1990

BT-704D: Biometallurgy

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I (10L)

Introduction to Biotechnology applied to Raw Material processing, Biogeochemical reactions – chemical mechanisms and controlling factors, Microbial interventions, Nature and characteristics of Biogeochemically important micro-organisms.

Module II (10L)

Kinetics of bioleaching; Applications of biogeochemical processes in mining and metallurgy, dump, heap and in-situ leaching.

Module III (10L)

Reactor modelling for leaching, beneficiation of ores and process residues: recovery of gold and silver, beneficiation of sulfidic tailings from tin processing; purification of ferroginous sand.

Module IV (10L)

Beneficiation of bauxite, applications of sulphate reducing bacteria; applications of sulphate reducing bacteria. Environmental pollution control: accumulation of metals by microbial cells; growth of microbial cells in water flowing pipelines; microbial degradation of water-based metal working fluids.

References :

1. M.E. Curtin, Microbial mining and metal recovery biotechnology (1), pp 229-235, 1983

2. Woods D, Rawling D.E., Bacterial bleaching and biomining in marx J.L. (ed), Revolution in biotechnology, Cambridge University Pres

BT-704E: Proteomics and protein engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I: 10L: Proteomics:

Introduction to proteomics; Two dimensional electrophoresis (2-D PAGE): Protein pre-fractionation and sample preparation, IEF, SDS-PAGE, visualization of protein spot. Protein identification by mass spectrometry: ESI-TOF, MALDI-TOF, MS/MS, PMF, protein sequencing; Post translational modification, Application of proteome analysis;

Module II: 10L Proteomics in drug discovery, delivery and diagnosis:

Proteomics in Drug Development; Diagnosis of diseases by Proteomics; Protein array; Discovery of new biomarker; identification of protein-protein interactions and protein complexes; proteomics in drug delivery**,** Functional genomics: Reverse genetics**,** Transcription and replication of negative strand viruses;

Module III: 10L: Protein engineering:

Introduction to steps of Protein design and Engineering, protein splicing and its application; Solid phase peptide synthesis, Production of Novel Proteins; Random and site directed mutagenesis, Methods for Expressing Recombinant Proteins; Characterization of Proteins structure: Crystallography and X-Ray Diffraction, Spectroscopy (UV-VIS, NMR and Fluorescence Spectroscopy) and Calorimetric Methods. Industrial applications of Protein Engineering (Engineering of Stability, affinity for substrate, Protease Specificity, Cofactor requirements of Protein).

Module IV: 10L Protein stability and folding:

Overview of protein structure, Higher level structure, Protein stability, Mechanism of protein folding (types, level, thermodynamics, Anfinsen's dogma & Levinthol paradox& kinetics), Folding Rate, Molten globule; Techniques for studying of protein folding;: NMR, CD spectroscopy, Proteolysis, Optical tweezers; Computational method; Location and functions of Molecular chaperones, chaperonin and co-chaperons, HSP chaperone system in *Ecoli* & Human; Proteasomes and proteosome mediated protein degradation; Protein folding errors: Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and cancer. Polyketides and non-ribosomal peptides; Combinational manipulation of polyketides and non ribosomal peptides; application of protein folding to design new drug.

Textbooks

1. R.M. Twyman ; Principles of Proteomics, Bioscientific Publishers
2. Daniel C. Liebler, Introduction to Proteomics: Tools for the New Biology, Humana Press

Reference Books

1. B.Alberts,D.Bray, J.Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y 1983
2. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd
3. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993.
4. Lilia Alberghina., Protein Engineering in Industrial Biotechnology, Harwood Academic publishers, 2003
3. Biochemistry & Molecular Biology Practical by Wilson and Walker
4. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages.

BT-704F: Human Genomics

Note 1 : There will be one compulsory objective type question comprising ten numbersspread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I: 10L

Human genome project

- HGP – background, timeline, findings
- Patterns of Genome organization
- Personalized medicine and Pharmacogenomics

Module II: 10L

Genome mapping, assembly

- Genome mapping techniques – physical and cytologic mapping
- Genome sequencing – Clone by clone sequencing, Whole genome shotgun sequencing, Hybrid sequencing, and other modern sequencing methods.
- Genome sequence assembly and annotation

Module III: 10L

Functional Genomics and comparative genomics

- Sequence based approaches
- Micro array based approaches
- Whole genome alignment
- Constructing minimal genome
- Lateral gene transfer

Module IV: 10L

Applications of SNP Technology in Genomics

- SNPs and Haplotype maps
- Linkage Disquilibrium (LD) and association studies
- QTL mapping
- SNP genotyoing – Low-technology and minisequencing methods
- Genomics basis of polygenic disorders – Diabetes, Cardiovascular disease, obesity

Textbook:

1. T. A. Brown , Genomes 3, John Wiley & Sons

Reference Books

2. Singer.M, and Berg.P, Genes and genomes, Blackwell Scientific Publication, Oxford,1991
3. Primrose and Twyman, Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing
4. Glick and Pasteurneck, Molecular Biotechnology, Principles and Applications of Recombinant DNA technology, ASM Press
5. Cantor & Smith, Genomics, John Wiley & Sons.
6. Strachan & Read, Human Molecular Genetics, 3rd edition, Garland Science.
7. Gibson G. and Spencer V.M. A Primer of Genome Science, 2nd edition, Sinauer Associates Inc.

CHE-701: Process Instrumentation and control

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I: 10 L Introduction

Introduction, Principles of measurement, Error Analysis, Static and dynamic characteristics of instruments, Process Instrumentation:Recording, indicating and signaling instruments , Transmission of instrument readings, Instrumentation diagram , Industrial instruments for measurement

a. Temperature: Filled system Thermometer, Thermocouples, resistance thermometers, radiation and optical pyrometers
b. Pressure: Manometers, elastic deformation and electrical type gauges. Vacuum gauges – mechanical, electrical and ionization types.
c. Flow: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters.
d. Level: Direct and inferential type

Measurement of density and specific gravity, humidity, viscosity and composition. Analytical principles involving emission spectrometry, IR, Spectroscopy, Gas chromatography, Polarography, X-ray and pH.

Module II: 10 L Simple system analysis:

Laplace transform, block diagram, Forcing function, Concept of transfer function, Transient response of first, second and higher order systems. Linearization, Transportation lag, Lumped and distributed parameter system.
Feed back control: Control loop and its components, servo and regulator control, Principle of automatic control with reference to proportional, integral and derivative modes.

Module III: 10 L

Stability Concepts: Routh-Hertwitz method, root-locus method and Bode diagrams. Controller tuning : Zigler Nicols method and Process reaction curve

Module IV: 10 L

Control hardware: Measurement elements and dynamics, final control elements – sizing and characteristics. Pneumatic and electronic controller. Elementary idea of feed forward, cascade, ratio, adaptive and digital computer control, Control of complex processes such as distillation column , heat exchanger and bioreactor.

Textbooks

1. D. R. Coughanowr , Process system analysis & Control , 2nd Ed–MGH.

References books:

1. G. Stephanopoulus , Chemical Process Control –PHI.
2. B. C. Nakra & K. K. Chaudhury , Instrumentation, Measurement and Analysis, TMH.
3. B. C. Kuo, Automatic process control, 4th ed
4. Smith & Carripio , Instrumentation and Control
5. Roffel,Advanced Process Control,Springer

HU-781: Group Discussion & Professionalism

L-T-P = 0-0-2

BT-791: Bioreactor Design & Analysis Lab

L-T-P = 0-0-3

1. To determine exit age distribution curve ‘E’ for liquid flowing through a vessel (RTD)
2. To determine yield factor $Y_{x/s}$ for yeast growth.
3. Transforming an experimental C_{pulse} curve in to an E curve.

4. To determine the relation between F and E curves
5. To develop a flow model to represent the vessel from the tracer output data presented graphically.
6. Calculate the vessel dispersion number D/uL from C_{pulse} vs. tracer response data (t) from the same vessel.
7. To determine the height of a packed bed reactor.

BT-792: Food Biotechnology Lab
L-T-P = 0-0-3
Any five experiments of the following experiments:
1. Isolation and Characterization of food fermenting organism from idli batter.
2. Estimation of ascorbic acid from given food sample by titrimetric method.
3. Analysis of mycotoxin (Aflatoxin) in fungus contaminated food material.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.

References :-
1. Gaud R.S. (2000), Practical biotechnology, Nirali Prakashan.
2. Sadashivam S. and Manickam A. (1996), Biochemical Methods, 2nd Edi. New age International (P) Ltd., Publications, New Delhi.
3. Schmauder Hans Peter (1997), Methods in Biotechnology, Taylor and Francis, London.
4. Sharma P.K and Dandiya P.C (2004), Pharmaceutical Biochemistry: Theory and Practicals, Vallabh Prakashan , Delhi.
5. Thimmaiah S.K (2006), Standard Methods of Biochemical Analysis, Kalyani Publishers,

CHE-783: Process Instrumentation & Control Lab
L-T-P = 0-0-3

1.0 Temperature Measurement using Resistance Temperature Detector (RTD), Thermocouple.
2.0 Pressure gauge calibration using Dead Weight Tester
3.0 Liquid-Level Measurement using Air-Purge Method
4.0 Measurement using Load Cell
5.0 Study on Responses of First and second-Order Interacting and non-interacting Systems
6.0 Studies on Characteristics of Control Valve
7.0 Studies on the Stability and tuning of a Flow Controller
8.0 Response of a P & PI Controller
9.0 Demonstration of Bourdon tube, diaphragm gauge, etc.

BT-793: Seminar
L-T-P = 0-0-2
Seminar: (Review of any field related to biotechnology and present a Research Paper related to any field of biotechnology, by PPT)

Each candidate shall do a review on any field related to biotechnology, and present a Research Paper on that same field by PPT in a departmental seminar during a period not exceeding 30 minutes. Performance of the candidates in the seminar shall be evaluated jointly by one External and all Internal Examiners.

BT-794: Project Work-I (Project Report)
L-T-P = 0-0-6
Project work I (Project Report):

During Semester-VII, each candidate shall carry out some investigative work independently or under the supervision of one or more guides(s), who may be Teacher / Guest Teacher of the College / Scientist of any Recognized Research Institute or University in collaboration with the teacher from the respective engineering colleges. The work may be carried out either in the College / University or in any Recognized Research Institute in collaboration, with the approval of the appropriate authority of the College. The findings of the project work should be submitted in the form of a report for evaluation by Internal Examiner.

BT-795: Industrial training
(Summer Training Report, Poster Presentation of the training work & Viva Voce)

Each candidate submit individual report of their summer training (six to eight weeks summer training done at end of 6th Semester) with certificate from the supervisor from the training company, research institute or University. The students present their training work by posters in a departmental poster presentation. Performance of the students in the poster presentation shall be evaluated jointly by one External and Internal Examiners.

8th Semester

HU(BT)-801: **Bioethics, Biosafety, IPR & Entrepreneurship in Biotechnology**

Note1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module- 1: (10L) Bioethics:

Introduction to ethics and bioethics, roots of honours and integrity in science; the responsible conducts of biotechnological research; research with human beings; societal obligation of a biotechnologist; **Ethical legal social issues (ELSI) in biotechnology:** Biotechnology/ biomedicine application – ethical consideration; ethics and the natural world: environmental ethics (protecting public health and environment; genetically modified foods – the ethical and social issue. ELSI in genetic engineering. / biomedical science, eugenic enhancement, eugenic genetic engineering., genetic information – use and abuse; patenting human genes – ethical and policy issue, ethics in cloning, genetic testing and screening, human gene therapy and genetic modification – ethical and public consideration, legal implication of somatic cell, gene therapy- germ line gene therapy.

Module II: (10L) Intellectual Property Rights (IPR), Patents and protection:

IPR: Jurisprudential definition and concept of property rights, duties and their correlations, history and evaluation of IPR – like patent design and copy right. Distinction among the various forms of IPR, requirements of a patentable invention like novelty, inventive step and prior art and state of art procedure; Rights/ protection, infringement or violation, remedies against infringement, civil and criminal, Indian patent act 1970 (2000) international convention in IPR, major changes in Indian patent system as post TRIPS-GATT-International conventions effects. Contents of patent specification and procedure for patents: a) obtaining patents, b) geographical indication c) WTO. Detailed information on patenting biological products, Biodiversity and farmer rights, Budapest treaty. Case studies on - Patents (basmati rice, turmeric, neem, etc.)

Module-III: Biosafety-Regulatory Framework In India & International Level:

Biosafety: The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved ingenerating new forms of life for informed decision making, biosafety regulation and national & international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, levels of safety. **Regulations on ethical principles in biomedical/ biotechnological practice**: The Nuremberg code, declaration of Helsinki; the Belmont report, cooperational guidelines – WHO, guidelines of DBT (India), Guidelines of an informed consent.

Different regulatory bodies in India (RDAC), (IBC), (GEAC), (SBCC), (DLC). Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety

Module IV: **(10L): Entrepreneurship – Objectives and Fundamentals:**
Entrepreneur & Entrepreneurship concept: role of entrepreneurship in economic development; factors affecting entrepreneurial growth; developing and evaluating opportunities; securing resources – institutional finance to entrepreneurs, lease financing & hire purchase, institutional support to entrepreneurs; statutory & legal requirements for starting a venture/ company; how to write a business plan. **Growing & sustaining enterprise:** Developing start-up strategies, measuring market opportunities, How to use IT for business administration, **Role of knowledge centres**: Knowledge centres like Universities & research Institution, Role of technology & upgradation, managing technology transfer, regulations for transfer of foreign technologies, support mechanism for entrepreneurship in India.

REFERENCES:
1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. ND.
2. Sasson A, Biotechnologies and Development, UNESCO Publications.
3. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi
4. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, ND.
5. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi.
6. P.K. Gupta, Biotechnology and Genomics, Rastogi Publications
7. Patent Strategy For Researches & Research Manegers- Knight, Wiley Publications.
8. Agriculture & Intellectual & Property Rights, V. Santaniello & R E Evenson, UniversityPress.
9. Intellectual Property Protection & Sustainable Development, Phillipe Cullet, Ldexix Nexis Butterworths.
10. Biotechnology & Safety Assessment, Thomas, Ane/Rout Publishers.
11. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru (Pearson Education)

BT-801: Medical and Pharmaceutical Biotechnology
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module 1: 10L: Drug Development in Pharmaceutical Process:
Introduction to production, formulation and packaging of large and small molecule pharmaceuticals; Generation of large molecule pharmaceuticals by natural extraction (Blood products, Haemophilia A and B, Anticoagulants, Thrombolytic agents) and recombinant methods (hormones, interferon's and Erythropoietin as biopharmaceutical); distinctions from small molecule pharmaceuticals; Microbial transformation for production of important pharmaceuticals (steroids and semi-synthetic antibiotics); New techniques for production of the above large molecule pharmaceuticals and their advantages/ therapeutic applications; Techniques for development of new generation antibiotics; Basic principles of protein modification and drug design *applied* to the above large molecule pharmaceuticals.

Module II: 10L: Disease Diagnosis and Therapy:
Immunodiagnostics and therapy: Introduction, hybridoma technology, Antibody markers, CD Markers, FACS, HLA typing, Bioassays. Therapeutic Antibodies for in vivo application, different types of ELISA, problems and prospects from mouse. Vaccine: introduction, types, Vaccine technology, DNA vaccine, Vaccines for AIDS, and cancer; DNA and RNA based diagnostics and therapy: PCR, PCR/OLA procedures, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Genotyping, Case studies related to bacterial, viral and parasitic infections. Gene Therapy, Antisense RNA therapy,

Ribozyme therapy, status, problems and prospects of further development. Toxicogenomics: Use of toxicological profiles and information in genomics; need and development.

Module III: 10L: Proteomics in Drug Development:
Role of Proteomics in Drug Development; Development and Application of proteomics and proteomics derived techniques to the drug development process. Use of proteomics in protein based biomarkers in disease diagnosis (e.g. cancer); development and future prospects. Growth in technological capability and applications of proteomics based separation and identification techniques (e.g. CE, HPLC, coupled to MS); applications to drug development. Development, types and applications of enzyme immunoassays for diagnosis;

Module IV: 10L: Clinical Diagnosis and Kit Development:
Use of enzymes in clinical diagnosis and kit development: Principle of diagnostic enzymology, determination/use of enzyme/enzyme activities for clinical diagnosis (Liver, cardiac and Kidney enzyme, Digestive enzyme, Miscellaneous enzymes and their general function tests); Biosensors: principle, types and applications of biosensor, Use of biosensors for rapid clinical analysis, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, application Nanotechnology in biosensor; Developing diagnostic kits for clinical analysis in small quantities.

Textbooks

1. Biopharmaceuticals- Biochemistry and Biotechnology : Gary Walsh; John Wiley & Sons
2. S. P. Vyas, V. Dixit, Pharmaceutical Biotechnology, CBS Publishers

Reference Books

1. Pharmaceutical Biotechnology ; Sambhamurthy & Kar , NewAge Publishers
2. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London
3. V.Venkatesharalu -Biopharmaceutics and Pharmacokinetics-Pharma Books Syndicate
1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
4. Diagnostic Microbiology, Balley & Scott's.
5. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood.
6. The Science of Laboratory Diagnosis, Crocker Burnett

BT-802A: Renewable Energy Technology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I (10L)
Biological fuel generation: Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes; conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and / or fermentation processes.

Module II (10L)
Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

Module III (10L)

Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xantham gum), biosurfactants.

Module IV (10L)

Solar energy: solar collectors, solar pond, photovoltaic cells, chemical storage. Geothermal energy and wind energy: Use of geothermal energy, operating principles of different types of wind energy mills. Nuclear energy: nuclear reactions and power generating tidal wave energy.

Reference books :

1) J.E. Smith – Biotechnology, 3rd ed. Cambridge Univ Press
2) S. Sarkar – Fuels and combustion, 2nd ed., University Press.

802B: Tissue Engineering

BT-802C: Biomedical Engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I

Introduction to cell structure and components, protein structure, cell membranes, chromosomes, cytoskeleton, actin filaments, microtubules, cell signaling and ECM, biomenmbrane and action potentials. Transducers and electrodes, types of transducers and their selection for biomedical applications, biosensors based on electrochemical transducers

Module II

Cardiovascular systems, the heart ad other cardiac systems, circulation and blood flow, blood pressure, cardiac output, cardiac rate, cardiac shock and response to exercise, magnet cardiography, cardiac pacemaker, computer applications. Measurement of electrical activities in muscles and brain; electromyography, electroencephalographs and their interpretation.

Module III

Membrane transport, kidney and nervous system in the control of arterial pressure, kidney function, functional problems in kidney, artificial kidney, dialysis, haemodialysis, blood transfusion, prosthetics- medical application of biopolymers, artificial intelligence in medical diagnosis (soft computing and genetic algorithm).

Module IV

Biomedical tests; Measurement of sugar, pH, sodium potassium ions, haemoglobin, oxygen and carbon dioxide concentration in blood, Medical imaging, ultrasound imaging, radiography, biotelemetry, biophysics of signal transmission and reception of biological signals, telemedicine.

References

1. Khandpur .R. S Handbook of biomedical Instrumentation.
2. Manz and Becker ,Ed,Micriosystem technology in Chemistry and Life Sciences
3. Webster J.S Medical Instrumentation Application and Design

BT-802D: Post-harvest Technology

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module I

Physico-chemical properties of grain, psychometry: Dry bulb and wet bulb temp, humidity, heat capacity of humid air. Grain drying: drying curves and their rates: methods of grain drying; grain dryers. Parboiling of paddy and wheat: Physico-chemical changes during parboiling; effects of parboiling on the quantity of grains.

Module II

Grain millings: cleaning and separation methods; Husking/Hulling machines; machine used in cereal grinding. Hydrothermal treatment of cereal grains; changes in physico-thermal and biochemical properties. Rice milling: cleaning machines, husking machines, types and characteristics, millings of corn, wheat and pulses: dry millings and wet millings; Flour milling, modern methods of pulses milling.

Module III

Processing of oil seeds and Rice bran: Production and refining of cotton seed oil,solvent extraction of soyabean oil, Extraction of sunflower oil, coconut oil, Methods of utilization of rice bran: wet heat treatment, rice bran stabilization; refining of crude rice bran oil with edible grade oil.

Module IV

Storage of food grain: grain storage principles; changes occurring in food grain---chemical, physical and biological. Grain storage, pests and their control; control of stored food grain pests by fumigation; rodent control, rodenticides for rats and mice. Food grain storage structures; bag and bulk storage; economics of storage and processing of rice.

References:

1) A. Chakraborty--- Post harvest technology of cereals, pulses and oil seeds, 1995
2) Boumans, G., Grain Handlings and storage, Development in Agricultural Engg., Elsevier, Tokyo, 1988

BT-802E: Metabolic Engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module-I (10l): Introduction

Induction-Jacob Monod Model, catabolite regulation, glucose effect, camp deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, permeability control passive diffusion, facilitated diffusion, active transport group transportation.

Module-II (10L): Synthesis of Primary & Secondary Metabolites

Biosynthesis of Primary Metabolites: alteration of feed back regulation, limiting accumulation of end products, feed back, resistant mutants, alteration of permeability. **Biosynthesis of Secondary Metabolites:** precursor effects, prophophase, idiophase relationships, enzyme induction, feed back regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

Module-III (10L): Bioconversions

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

Module-IV(10L): Regulation Of Enzyme Production

Strain selection, improving fermentation, recognizing growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

Reference 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 Wiles and Sons., 1980.
2. Peter, F. Stanbury., Stephen, J. Hall and Whitaker, A.,Principles of Fermentation Technology, Elsevier, Science and Technology Books, New Delhi, 2nd Edition,2005
3. Zubay, G., Biochemistry, McGraw Hill Publishers, New Delhi, 4th Edition, 1999

BT-803F: Tissue Engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 40 hrs/sem**

Module-I

Stem cells, Morphogenesis generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, The extracellular matrix as a biologic scaffold for tissue engineering,

Module II

Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering, Degradation of bioceramics, Biocompatibility.

Module-III

Cell source, Cell culture harvest selection expansion and differentiation, Cell nutrition,
Cryobiology, Bioreactors for tissue engineering

Module-IV

Scaffold design and fabrication, Controlled release strategies in tissue engineering, Tissue engineering for skin transplantation, Tissue engineering of: cartilage, bone, for nervous system, organ system, Ethical issues in tissue engineering.

Text Book:

1. Tissue Engineering (2008) by C. van Blitterswijk, P. Thomsen, J. Hubbell, R. Cancedda, J.D. de Bruijn, A. Lindahl, J. Sohier, D. Williams Academic Press .

Ref. books:

1. Principles of Tissue Engineering (1997) by Robert Lanza, Robert Langer, Joseph P. Vacanti

Academic Press,

2. Tissue Engineering: Roles, Materials and Applications (2008) by Steven J. Barnes, Lawrence P. Harris, Nova publication

BT-891: Design Lab /Industrial problem/ Industrial related training
L-T-P = 0-0-6

BT-892: Project work-II
L-T-P = 0-0-12
Project work II:

During Semester-VIII, each candidate shall carry out some investigative work independently under the supervision of one or more guides(s), who may be Teacher / Guest Teacher of the College / Scientist of any Recognized Research Institute or University in collaboration. The work may be carried out either in the College / University or in any Recognized Research Institute in collaboration, with the approval of the appropriate authority of the College. The evaluation of project work will be done by supervisor of the project.

BT-893: Project Work-II Report and Defence Seminar by PPT
Project work II:

The findings of the project work II should be submitted as an individual report in the form of a dissertation for evaluation. The student present a defense seminar by PPT on the project work-II, in a departmental seminar during a period not exceeding 30 minutes in presence of an External Expert and all internal examiner for viva voce on the project.

BT-894: Grand Viva (Comprehensive Viva Voce)
Comprehensive Grand Viva-Voce:

Grand Viva-Voce examination shall be conducted jointly by the External and Internal Examiners. Short questions on the theoretical principles, experimental methodologies, instrumentations etc. of the different theory and experiments included in the entire theory and practical syllabus of Semesters-I, -II, -III, -IV, -V, -VI, -VII, and -VIII may be asked. The candidate may be asked to answer the questions verbally or in writing. Maximum time for viva-voce examination of a candidate shall not exceed 30 minutes.

Syllabus for B.Tech(Biotechnology) up to Third Year

Revised Syllabus of B.Tech BT (for the students who were admitted in Academic Session 2010-2011)