

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 3<sup>rd</sup> Semester**

**3<sup>rd</sup> semester**

Course No.	Subject	L	T	P	Marks		Total	Duration of Exam. Hrs.
					Int	Ext		
BT-201	Basic of Biotechnology-I	3	1	-	40	60	100	3
BT-203	Concepts in Bio-Techechnology	3	1	-	40	60	100	3
BT-205	Microbiology	3	1	-	40	60	100	3
BT-207	Bio-Chemistry	3	1	-	40	60	100	3
BT-209	Cell and Molecular Biology	3	1	-	40	60	100	3
BT-211	Process Thermodynamics	3	1	-	40	60	100	3
BT-213	Practical –I based on papers 201,203,205	-	-	2	30	20	50	
BT-215	Practical II based on papers 207,209,211	-	-	2	30	20	50	
	Workshop Training				60	40	100	
<b>Total</b>					<b>360</b>	<b>440</b>	<b>800</b>	

**Contact Hours: 28**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 4<sup>th</sup> Semester**

Course No.	Subject	L	T	P	Marks		Total	Duration of Exam. Hrs.
					Int	Ext		
BT-202	Concepts in Bio-Technology-II	3	1	-	40	60	100	3
BT-204	Industrial Microbiology	3	1	-	40	60	100	3
BT-206	Food bio-technology	3	1	-	40	60	100	3
BT-208	Transport Phenomenon	3	1	-	40	60	100	3
BT-210	Chemical Reaction Engg	3	1	-	40	60	100	3
BT-212	Intellectual property right bio-ethics and biosafety	3	1	-	40	60	100	3
BT-214	Practical –I based on papers 202,204,206	-	-	2	30	20	50	
BT-216	Practical II based on papers 208,210,212	-	-	2	30	20	50	
	General Fitness						100	
<b>Total</b>					<b>400</b>	<b>400</b>	<b>800</b>	

**Contact Hours: 28**

\*\* There should be industrial/institutional training of 6 weeks duration in the summer vacation after 4<sup>th</sup> semester

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 5<sup>th</sup> Semester**

Course No.	Subject	L	T	P	Marks		Total	Duration of Exam. Hrs.
					Int	Ext		
BT-301	Genetic Engg	3	1	-	40	60	100	3
BT-303	Immunology & Immunotechnology	3	1	-	40	60	100	3
BT-305	Animal cell culture & Biotechnology	3	1	-	40	60	100	3
BT-307	Enzyme Engineering & technology	3	1	-	40	60	100	3
BT-309	Bio-process Engg-I	3	1	-	40	60	100	3
BT-311	Bio-informatics	3	1	-	40	60	100	3
BT-313	Practical based on papers 301,305	-	-	2	30	20	50	
BT-315	Practical based on papers 307,309	-	-	2	30	20	50	
	Industrial Training				60	40	100	
<b>Total</b>					<b>360</b>	<b>440</b>	<b>800</b>	

**Contact Hours: 28**

**(Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 6<sup>th</sup> /7<sup>th</sup> Semester**

Course No.	Subject	L	T	P	Marks		Total	Duration of Exam. Hrs.
					Int	Ext		
BT-302	Microbial bio-technology	3	1	-	40	60	100	3
BT-304	Plant cell culture & Biotechnology	3	1	-	40	60	100	3
BT-306	Bio-Process Engg-II	3	1	-	40	60	100	3
BT-308	Bio-reactor Design & operation	3	1	-	40	60	100	3
BT-310	Down stream Processing	3	1	-	40	60	100	3
CE-216	Environmental Studies	3	1	-	40	60	100	3
BT-312	Practical –I based on papers 302,304,306	-	-	2	30	20	50	
BT-314	Practical II based on papers 308,310,312	-	-	2	30	20	50	
	General Fitness				100			
<b>Total</b>					<b>400</b>	<b>400</b>	<b>800</b>	

**Contact Hours: 28**

**( 6<sup>th</sup> / 7<sup>th</sup> Semester )**

Course No.	Subject	Marks Int.	Marks Ext.	Total	Duration of Exam Hrs.
BT-401	Industrial Training	500	500	1000	

**Total 1000**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 8<sup>th</sup> Semester**

Course No.	Subject	L	T	P	Marks Int.	Marks Ext.	Total	Duration of Exam Hrs.
BT-402	Major Project	-	-	8	60	40	100	3 Hrs
BT-404	Enzyme Catalysed Organic Synthesis	3	1	-	40	60	100	3 Hrs
BT-406	Project Management and Entrepreneurship	3	1	-	40	60	100	3 Hrs
BT-408	Modelling & Simulation of Bioprocesses	3	1	-	40	60	100	3 Hrs
BT-410	Bioanalytical Techniques	3	1	-	40	60	100	3 Hrs
	Elective – I	3	1	-	40	60	100	3 Hrs
	Elective – II	3	1	-	40	60	100	3 Hrs
BT-422	Practical based on Papers 404, 406, 408	-	-	2	30	20	50	4 Hrs
BT-424	Practical based on Papers 410, 416 or 418 or 420 and 422 or 424	-	-	2	30	20	50	4 Hrs
	General Fitness				100		100	
<b>Total</b>							<b>900</b>	

**Options in Electives:**

- BT-412 Biomaterials
- BT-414 Biomedical Engineering
- BT-416 Introduction to Microelectromechanical systems and Nanobiotechnology
- BT-418 Environmental and Occupational Toxicology
- BT-420 Advances in Drug design and drug delivery systems and Pharmacogenomics

**BT- 201 BASICS OF BIOTECHNOLOGY****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Introduction of Life :  
 Characteristics of living  
 A hierarchy of organization and factors responsible for regulating different levels of organisms.  
 Cellular basis of life
2. Structure and Functions of Macromolecules :  
 Carbohydrates.  
 Lipids  
 Proteins  
 Nucleic acids
3. Enzyme as biocatalysts :  
 Structure and Functions, Factors affecting activities of enzymes.
4. Plant Anatomy and physiology :  
 Parts of a flowering plant and their functions with special reference to their role in  
 Absorption  
 Nutrition  
 Photosynthesis  
 Reproduction  
 Growth regulators.
5. Animal Anatomy and physiology:  
 Elementary Study of Digestive  
 Respiratory Circulatory  
 Excretory  
 Reproduction  
 System and their functions.  
 Bio-regulatory Mechanisms
6. Genetics :  
 Mitosis and Meiosis  
 Bio-chemical basis of inheritance  
 Central Dogma
7. Evolution:  
 Theories of evolution Gene Pool and genetic basis of variation
8. Ecology:  
 Basic concept, ecosystem, energy cycles, population growth patterns
9. Introduction to Biotechnology:  
 Definition  
 Scope and achievement  
 Tools used in biotechnology
10. Genetic Engineering  
 Element : Knowledge of Recombinant DNA  
 BIO-Informatics and Genomics
11. Applications of Biotechnology in  
 Agricultural  
 Medicine  
 Environment.

**Books :**

Life Scene of Biology y by Williams K. Purves. David Sadava. Gordon H. Orians and H. Criag Heller W.H. Freman & Company ISA 6<sup>th</sup> edition (2001)

1. Cell Biology and Genetics by Cecic Starr and Ralph Taggard : Brokks/Cole. Thomson Learning USA : 9<sup>TH</sup> Edition (2001)
2. A Text Book of Biotechnology by H.D. Kumar, Affiliated East-West Press. Private Ltd New Delhi, 2<sup>nd</sup> Edition (2002)
3. Basic Biotechnology by Rev Fr. Dr. S. Ignacimuthu. Tata McGrawhill Publication Company Ltd., New Delhi (2002)
4. Genes VII by Benjamin Lewis Oxford univ. Press (2002).

**BT- 203 CONCEPT IN BIOTECHNOLOGY-I**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Introduction to Biotechnology : Historical perspectives. Emergence of modern biotechnology, Branches/scope of biotechnology.  
 Biological Systems in Biotechnology: Prokaryotic systems: E.coli, Bacillus. Eukaryotic system : Saccharomyces., mammalian and non-mammalian cells in culture, organismal systems.  
 Basic techniques in bio-Technology  
 Centrifugation : Principle, types and applications  
 Electrophoresis : Principle, support media, protein and N.S. Electrophoresis.  
 Chromatography : Principle, types and application  
 Lyophilization : Principle, mechanism, application.  
 Basic microscopy : Principle, various types of microscopes , introduction to electron microscopy.  
 Radiosotopy : Various types of radio isotopes, instrumentation.

Basic Genetics and Genetic Manipulations.  
 Mendelian inheritance.  
 Physical basis of inheritance  
 Gene interactions.  
 Genomic and mitochondrial DNA.  
 C value paradox , cot curve,  
 Cytoplasmic inheritance,  
 Nucleo-cytoplasmic interactions.  
 Development and evolutionary genetics.

## Books :

- 1 Biotol Series (I-VI), 1992: Techniques used in Bioproduct Analysis-Buterworth Heineman, UK.
- 2 McGregor, C.W., 1986: Membrane Separation in Biotech, Marcel Dekker Inc, New York.
- 3 Juan H., and Sengo, A.A., 1985 Separation, Recovery and Purification in Biotech, American Chem, Society , Washington.
- 4 T.S. Work Lab, Techniques in Biochemistry and Molecular Biology, 1984, Elsevier , New York
- 5 S. Friefelder : Physical Biochemistry , Freeman and Co., New York.

**BT-205 MICROBIOLOGY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. History of Microbiology , Germ theory, Disciplines of Microbiology.
2. Microbial taxonomy including modern approaches of taxonomy such as DNA taxonomy and numerical taxonomy, different groups in bacteria.
3. Microbial growth : Synchronous & asynchronous, pure cultures, growth inhibitory substances.
4. Microbial genetics, transformation, conjugation & transduction.
5. Microbial metabolism : Nutrition, media and methods, effects of environment , metabolic products of industrial importance metabolic pathways amphotrophic and biosynthetic
6. Microbial ecology (n with particular reference to C.N. Cycles)
7. Microbes as pathogens important microbial pathogens, toxins, mode of action of toxins.

**Books:**

1. Pelezar, M.J. and Chan, E.C.S. (Jr.), 2000: Microbiology, Tata McGraw Hill Pub. Co., New Delhi
2. Bernard D.D. Dulbecco, R.Eisen, H.N. and Ginsberg, h.S. 1990: Medical Microbiology, Harper and Row, New York.
3. Waites, M.J. et al., 2001: Industrial Microbiology, Blackwell Science Ltd. London
4. Nicklin J. et al. 2001: Instant Notes in Microbiology, BIOS Scientific Publishers Ltd. U.K.
5. Tortora G.J. et al. 1995: Microbiology An introduction, Benjamin/ Cummings Pub. Co. Inc.

**BT –207 : BIOCHEMISTRY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Biomolecules: Chemistry and properties of amino acids, proteins, carbohydrates, lipids, purines, pyrimidines and vitamins.
2. Chemical Bonds: Covalent bonds, ionic bonds, co- ordinate bonds, hydrogen bonds, vander waal forces, hydrophobic interactions, diode interactions.
3. Proteins : Primary, secondary, tertiary and quaternary structure, proteins analysis, methods for isolation and purification of proteins
4. Fat Metabolism : Oxidation of fatty acids, synthesis of fatty acids (fatty acid synthesis complex system), ketone bodies
5. Carbohydrates Metabolism : Glycolysis, glycogenolysis, glycogenesis and their regulations, citric acid cycle.
6. Amino acid Metabolism : Oxidative degradation and synthesis of amino acids, estimation of amino acids
7. Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines, their regulation amd catabolism
8. Mitochondria: Structure of mitochondria, organization of respiratory chain, oxidative phosphorylation and its inhibitors
9. Plant & Microbial Biochemistry : Photosynthesis, differences in respiratory mechanisms and anherobes.
10. N2- fixation : role of various enzymes in Nitrogen cycle.

**Books:**

1. B.D. Hames et al: Instant Notes in Biochemistry, BIOS Sci. Pub. Ltd. U.K. (2001)
2. G. Zubay: Biochemistry, W.C. Brown Publishers, Oxford, England (1993).
3. L. Stryer: Biochemistry, W.H. Freeman and Company, New York (1995)
4. A.L. Lehninger: Principles of Biochemistry, worth publishers, New York (1994)

**BT- 209: CELL AND MOLECULAR BIOLOGY****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Evolution of cell.
2. Membrane structure and function, cytoskeleton, ECM and its role in cell behaviour regulation
3. Chromosomes and organisation of DNA and RNA
4. DNA replication in Prokaryotes and Eukaryotes: Basic process, enzymes involved in replication regulation
5. DNA Recombination: Molecular mechanisms in prokaryotic cells and eukaryotic cells.
6. Insertion Elements and Transposogenesis: Background, types mechanism of transposition, application
7. DNA damage and repair: types of damage, mechanisms of repair.
8. Mutations, Microbial Genetics: types of mutations, mutagens, mutagenesis with directed mutagenesis.
9. Prokaryotic Gene Expression Lac operon, regulation of gene expression of in eukaryotes.
10. Transcription in Prokaryotic and Eukaryotic Cells : Mechanism factors, regulatory mechanisms, post transcriptional changes Eukaryotes including RNA editing.
11. Translation in Prokaryotic and Eukaryotic Cells : Stages, molecules involved, RNAs, mRNA storage in oocytes., differential translation post transcriptional changes in eukaryotes.
12. Cell Cycle and its regulation Phase of cell cycle, cell cycle check points, factors involved in cell cycle regulation.
13. Signal Transduction : Types, receptors , molecules, mechanisms.
14. Stem Cell Biology : History, definitions, basic technology, applications.
15. Role of Molecular Biology in Molecular Medicine: Molecular probes, introduction to gene therapy, molecular drugs.

**Books :**

- 1 Lewin . B. 2002 : Gene VII, Oxford University, Press, New York.
- 2 Russo , V.E.A 1992, Molecular Genetic Approach, Springer Verlag.Berlin.
- 3 Maloy, RE. Stanely, 1994: Microbial Genetics, Jones and Barlett , England
- 4 Kendrew, S.J. 1994: The Encyclopaedia of Molecular Biology, Blockwell . U.K.

**BT 211 : PROCESS THERMODYNAMICS**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Thermodynamic Functions : Laws of thermodynamics , thermodynamic cycles, properties of steam and sterilization.

Heat effect, Standard Heat of Formation : Heat of reaction : Free energy of formation : Refrigeration and liquefaction : Thermodynamics of solution, Raoult's law : activity coefficients : fluid phase equilibrium from equation of state: chemical reaction equilibrium : standard free energy change and equilibrium constant, effects of temperature on free energy change, equilibrium constant, equilibrium conversion.

Application of thermodynamics on bio-systems i.e., cell, fermentation processes, substrate utilization etc.

Books:

1. David Friefelder : Physical Biochemistry , Freeman and Co., New York.
2. Elsevier : Lab Techniques in Biochemistry and Molecular Biology, New York ( latest Edition).
3. Price & Steve: Fundamental of Enzymology.
4. D.S. Kumar : Thermodynamics S.K. Kataria and Sons.
5. Nag : Thermodynamics.

**SEMESTER IV****BT-202 : CONCEPTS IN BIO-TECHNOLOGY-II****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Plant Biotechnology :Plant Cell culture, types and applications, transgenic plants methodology and their applications.
2. Genetic Engineering of animals  
Basics of cell culture, setting up of primary cell lines, gene transfer in animal's cells, transgenic animals, methodology, applications.
3. Application of Biotechnology in Medicine  
Introduction to diagnostics & therapeutics , gene therapy.
4. Bioremediation and Biosensors  
Basic strategy of pollution combating using biotechnology with particular reference to oil spills, metals and pesticides. Introduction of biosensors.

**Books :**

- 1 Buterworth Heineman : Techniques used in Bioproduct Analysis-Biotol Series (I-IV), 1992. U.K.
2. Elsevier Lab Techniques in Biochemistry and Molecular Biology, New York.
3. Ausubel et al: Current Protocols in Molecular Biology, Green Publishing. Associates Inc and John Wiley and Sons Inc.

**BT-204 INDUSTRIAL MICROBIOLOGY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Industrially important microbes ( E.Coli, Bacillus, Actinomyces, Saceharmyees)
2. Preparation of an ideal growth medium for production of biomass and a microbial product.
3. Strain improvement by genetic means.
4. Culture preservation
5. Classification of microbial products.
6. Microbial fermentations. Introduction to design of fermenters.
7. Microbial processes for the production of organic acids, solvents, antibiotics enzymes, polysaccharides, lipids, pigment and aroma.
8. Equipments and accessories for industrial processes.
9. Microbial enzymes their stability, Enzyme stabilization by selection and genetical engineering protein engineering, reaction environment rebuilding. Chemical modification, intra-molecular cross linking and immobilization, role of enzymes in bio-conversions of industrially important compounds.
10. Genetically engineered microbes and their regulation : Introduction, their production, limitations and applications.

## Books :

1. M.J. Petezar and E.C.S. (Jr.) Chan, 2000 : Microbiology, Tta McGraw Hill Pub. Co., New Delhi.
2. D.D. Bernard, R. Dulbecco, H.N. Eisen, and H.S. Ginsbery , 1990: Medical Microbiology, Harper and Row, New York.
3. MK.J. Waites et al ., 2001 : Industrial Microbiology, Blackwell Science Ltd., London.
4. Nicklin et al., 2001: Instant Notes in Microbiology, BIOS Scientific Publishers Ltd, U.K.
5. G.J. Tortora et al 1995: Microbiology : An introduction, Benjamin/Cummings Pub Co., Inc.B.T.

**BT-206 FOOD BIOTECHNOLGY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Microbial role in food process operations and production, new proteins foods SCP, muschroom, food yeast's algal proteins, fermentation as a method of preparing and preserving foods.
2. Food additives like colouring, flavours and vitamins. Organisms and their use in pickling producing color and flavours , alcoholic beverages and other products.
3. Mechanism of enzyme function and reactions in process techniques- starch and sugar conversion process, baking by analysis, deoxygenating and desugaring by glucose oxides, beer mashing and chill- proofing cheese making by protease's and various other enzyme catalytic actions in food processing process wastes- whey, molasses, starch substrates and other food waste for bioconversion to useful products.

**Books:**

1. Food Microbiology : W.C. frazier and D.C. Westhoff, Tata McGraw Hill.
2. Nature of Enzymology : R.L. Foster
3. Biotechnology : P.K. Gupta
4. Biotechnology : B.D. Singh

**BT 208 : TRANSPORT PHENOMENA**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Transport of momentum, heat and mass by molecular motion- Newton's Law of Viscosity, Fourier's Law of heat conduction, Fick's Law of diffusion.

Transport properties – Viscosity, thermal conductivity and mass diffusivity.

Emphasis on the analogy between momentum, heat and mass transfer with respect to transport mechanism and governing equations.

Development of mathematical models of transfer processes through shell momentum balance, shell energy balance and shell mass balance for solving specific problems of transport of momentum, heat and mass in laminar flow or in solids in one dimensions.

Development of general differential equation of fluids flow, heat transfer and mass transfer and their applications in solving one- dimensional steady and unsteady state problems of momentum, heat and mass transfer.

Inter- phase transport of momentum, heat and mass and dimensionless correlation for each one of them.

Momentum, heat and mass transfer analogies.

Books:

1. Bird R.B. Stewart, W.E. : Transport Phenomenon (John Wiley & Sons)
2. Wiety, J.R. Wilson, R.E. and Wicks C.E. : Fundamental of Momentum heat and Mass Transfer (Jon Wiley & Sons)
3. Beeks W.J. and Muttzall : Transport Phenomena (John Wiley & Sons)
4. Bennett, C.O. and Myers, J.E. : Momentum, Heat and Mass Transfer
5. Robsenow, W.M. and Choi, H.Y. : Heat, Mass Transfer and Momentum (PHI)

**BT 210: CHEMICAL REACTION ENGINEERING**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Introduction & Brief review of the Kinetics of Homogeneous reactions  
Interpretation of rate data from constant volume and constant pressure systems  
Single ideal reactors  
Design for single reaction.  
Thermal characteristics of reactors temperature and pressure effects

Bio- chemical kinetics: Interpretation of bath kinetic data: kinetics of enzymes catalysed reactions in free and immobilized states: Michaelis- Menten equation and its various modifications: Effects of External mass transfer in immobilised enzymes systems: analysis of intraparticle diffusion and reaction: kinetics of substrate utilization, product formation and biomass production: Monod growth model and its various modifications. Structure and unstructured rate models: thermal death kinetics of cells and spores: transport phenomena in bioprocess systems, gas liquid mass transfer in the cellular systems

Books:

1. Levenspiel D : Chemical Reaction Engineering (John Wiley)
2. Smith J.M. : Chemical Engineering (McGraw Hill)
3. Wales S.M. : Reaction Kinetics for Chemical Engineers (McGraw Hill)
4. Denbigh, K. Turner K.G. : Chemical Reactor Theory- An Introduction (Cambridge Press)
5. Scott Fogler, H : Elements of Chemical Reaction Engineering (PHI)

**BT 212 : INTELLECTUAL PROPERTY RIGHT, BIOETHICS AND BIOSAFETY**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

1. Introduction : General introduction, Patent claims, the legal decision- making process. Ownership of tangible and intellectual property
2. Basic requirement of patentability : Patentable subject matter, novelty and public domain, non obviousness
3. Special issue in biotechnological patents: Disclosure requirements, collaborative research, competitive research, plant biotechnology, foreign patents
4. Patent Litigation : Substantive aspects of patent litigation, procedural aspects of patent litigation, recent developments in patent system and patentability of biotechnology invention. IPR issues in the Indian context current patent laws.
5. Public acceptance issues for Bio tech, case studies/ experience from developing and developed countries. Biotechnology and hunger. Challenges for the Indian, biotechnological research and industries
6. The Cartagena protocol on biosafety.
7. Biosafety Management: Key to the environmentally responsible use of biotechnology, Ethical implications of biotechnological products and techniques
8. Social and ethical implications of biological weapons.
9. Good safety practices, GLP Standards, lab contaminants, PI, PH, PHI guidelines

Books :

Good laboratory and clinical practices by P.A. Carson and N.J. Dent.

**SEMESTER FIVE****BT-301 GENETIC ENGINEERING****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

Introduction

Milestones in Genetic Engineering

Molecular tools and their applications Restriction enzymes, modification enzymes. DNA and RNA markers.

Gen Cloning Vectors. Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes.

Restriction Mapping of DNA fragments and Map Construction, Nucleic Acid Sequencing.

Cdna synthesis and Cloning. mRNA, enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening.

Alternative strategies of gene cloning. Cloning interacting genes-Two and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays.

Site-directed Mutagenesis and Protein Engineering.

How to Study Gene Regulation ? DNA transfection, Northern blot, primer extension, SI mapping. RNase protection assay. Reporter assays.

Expression Strategies for Heterologous Genes. Vector Engineering and codon optimisation, host engineering. In vitro transcription and translation, expression in bacteria, expression in Yeast , expression in insects and insect cells., expression in mammalian cells , expression in plants.

Processing of Recombinant Proteins Purification and refolding, characterization of recombinant proteins, stabilization proteins

Phage Display

T-DNA and Transposon Tagging. Role of gene tagging in gene analysis. T-DNA and transposon tagging , identification and isolation of genes through R-DNA or transposon.

Transgenic and Gene Knockout Technologies, targeted gene replacement, chromosome engineering.

Gene Therapy Vector engineering, Strategies of gene delivery , gene replacement/augmentation, gene correct, gene editing, gene regulation and silencing.

Books :

- 1 Molecular Biology and Biotechnology by Walker and Gingold, 1991 Royal Society of Chemistry, London.
- 2 Molecular Biology of Gene by Watson.J. et. Al ( 4<sup>th</sup> cd), 1994, Benjamin/Cummings. California, USA.
- 3 Molecular Biology of Cell by Alberts, B.et.al 1994, Garland Publishers Inc.
- 4 Recombinant DNA by Watson.J.D. et al, 1993, Scientific American Books, New York.
- 5 Principles of Gene Manipulation by Old, R.W. and Primrose, S.B. 1994 , Blackwell, U.K.
- 6 Recombinant Microbes for Industrial and Agricultural Applications by Murroka, I.I. 1994, Marcel Dekker, Inc, New York.
- 7 Methods in Gene Technology by Date, J.N., 1994, Jai Press Ltd, London, England.
- 8 Gene Cloning and Manipulation by Christopher Howe , 1995, Cambridge University Press.
- 9 Manual of Industrial Microbiology and Biotechnology A.L. Demain and J.E. Davis . 1999 ASM Press Washington DC.
- 10 Principles of gene manipulation by old R.W and Primrose S.B. 1994: Blackwell U.K.

**BT-303 : Immunology and Immunotechnology**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Phylogeny of Immune System  
 Innate and acquired immunity.  
 Clonal nature of immune response  
 Organization and structure of lymphoid organs  
 Nature and Biology of antigens and super antigens  
 Antibody structure and function  
 Antigen-antibody interactions  
 Major histocompatibility complex  
 BCR & TCR, generation of diversity  
 Complement system  
 Cells of the immune system: Hematopoiesis and differentiation, lymphocyte trafficking B-lymphocytes, T-Lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast Cells.  
 Regulation of immune response-Antigen processing and presentation, generation of humoral and cell mediated immune responses  
 Activation of B- and T- lymphocytes,  
 Cytokines and their role in immune regulation, T-cell regulation, MHC restriction, Immunological tolerance  
 Cell mediated cytotoxicity : Mechanism of T cell and NK cell mediated lysis. Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.  
 Hypersensitivity  
 Autoimmunity  
 Transplantation  
 Immunity to infectious agents ( intercellular parasites, helminthes and viruses)  
 Tumor immunology  
 AIDS and other immunodeficiencies.  
 Hybridoma Technology and Monoclonal antibodies  
 ELISA, RIA etc.

**Books :**

Immunology by Kuby.J. 2003, W.H. Freeman & Co., New York.  
 Cellular and Molecular Immunology by Abbas A.H. and Lichtman, A.H. and Pober, J.S. 1994 W.B. Saunders and Co. Philadelphia 2<sup>nd</sup> ed USA.  
 Monoclonal Antibodies by Ritter, M.A. 1995, Combridge University Press , New York

**BT-305 ANIMAL CELL CULTURE AND BIOTECHNOLOGY**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

Introduction, historical

Animal Cell metabolism, regulation and nutritional requirements;

Animal cell growth characteristics and kinetics;

Primary and secondary cultures.

Cell culture in continuous, perfusion and hollow-fibre reactor.

Mass transfer in mammalian cell culture ; Scale-up of cell culture processes; case studies.

Gene transfer in animal cells and its applications.

Contamination and cryo preservation

Transgenesis and transgenic animals including live stock.

Transgenics as bioreactors.

Biotechnology of aquaculture, silkworm, pest control.

Biodiversity characterization, conservation

In vitro fertilization

Embryo transfer technology

Stem cell Biology and Cloning.

Books :

Animal Biotechnology Vol I and II by Griffith and Smith

Animal Cell Culture by Freshney

**BT-307: ENZYME ENGINEERING AND TECHNOLOGY****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

## Introduction and Scope

General distinctive features and industrial applications.

Enzyme kinetics: single , substrate steady state kinetics

King-Altman's method

Inhibitors and activators: multi-substrate systems, effect of pH and temperature.

Allosteric enzymes.

Immobilization of enzymes, advantages, carriers, adsorption , covalent coupling., cross linking and entrapment methods; micro-environmental effect.

Mass transfer in enzyme reactors.

Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

## Books

- 1 Biotechnology By W.F. Guger and Ginger , 2003 ( Text Book of Industrial Microbiology)
- 2 Biochemical Engineering Fundamentals by J.E. Bailey and P.F. Ollis McGraw Hill Publication.
- 3 Biotechnology Vol 7 by H.J.R. Rehen and H.G. Reed; Beelar Publihers
- 4 Industrial Microbiology and Biotechnology by A.L. Demain and J.E. Davis 1999; ASM Press Washington DC.

**BT-309**

**BIOPROCESS ENGINEERING-I**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

Kinetics of microbial growth

Substrate utilization and product formation kinetics, simple structured models.

Design and optimisation of fermentation media#

Media sterilization , air sterilization

aseptic transfer

aeration and agitation

rheology of fermentation fluids

cell cultivation strategies

batch, fed-batch and continuous processes

scale up and scale down concepts

Books:

1. Principles of fermentation Technology : By Stainbury and Whitabar, Orgamon Press
2. Manual of Industrial Microbial and Biotechnology A.L. Deerman; J.E. Davis , 19999  
ASM Press; Washington D.C.

**BT 311 BIOINFORMATICS**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

Introduction, internet, intranet and extranet

Networking protocols

Database management system

Commercial application packages

Internet resources

Biomednet

Medicine

Protein/Nucleic acid sequence

Hybridoma

Electronic journals

Web Designing operating systems

Current trends in information technology

Books :

Bioinformatics : Methods and Protocols by S., Misener and S.A. Krawetz 2000 Humana Press

Totona, New Jersey.

**Semester-VI****BT-302 MICROBIAL BIO-TECHNOLOGY****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

Introduction

Microbial diversity and its applications

Nano-bacteria : characterization and applications.

Microbes as source of macromolecules

Novel approaches for antibacterial drug discovery i.e. drug targeting.

Manipulation of microbes for the production of enzyme. Insecticides. Polysaccharides

Pathogenic islands in bacteria

Microorganism in plant biotechnology

Microorganisms for bio energy

Microbial production and importance of

i) Bio-Surfactants

ii) Oilgenous microbes

Metabolic pathway engineering for the production of Antibiotics, alcohol and organic synthesis

Environmental applications for sewage management, degradation of Xenobiotics mineral recovery , removal of heavy metals for aqueous effluent.

**BT-304 : Plant Cell Culture and Biotechnology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

Conventional Plant Breeding

Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids

Tissue culture media ( composition and preparation)

Initiation and maintenance of callus and suspension culture : single cell clones.

Organogenesis : somatic embryogenesis; transfer and establishment of whole plants in soil.

Hoot-up culture ; rapid clonal propagation and production of virus-free plants

Embryo culture and embryo rescue

Protoplast isolation, culture and fusion : selection of hybrid cells and regeneration of hybrid plant. Symmetric and asymmetric hybrids. Cybrids.

Anther, pollen and ovary culture for production of haploid plants and homozygous lines.

Cryopreservation, slow growth and DNA banking for germ plasm conservation.

Plant Transformation Technology : basis of tumour formation, hairy root , features of TI and RI plasmids mechanisms of DNA transfer , role of virulence genes, use of TI and RI as vectors, binary vectors . Use of 35S and other promoters, genetic markers, reporter genes, use of scaffold.

Methods of nuclear transformation , viral vectors and their applications

Multiple gene transfers. Vectors less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots.

Transgene stability and gene silencing.

Application of Plant Transformation for productivity and performance herbicide resistance.

Phosphinothricin, glyphosate, sulfonyl urea, atrazine, insect resistance. Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, viroin resistance, coat protein mediated mucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP antifungal proteins , thionins, PR proteins, nematode resistance, abiotic stress, post-harvest losses, long shelf life of fruits and flowers. use of ACC synthase. poly galacturonase. ACC oxidase, male sterility lines, bar and barnase systems carbohydrate composition and storage. ADP glucose pyrophosphatase.

Chloroplast Transformation : advantages vectors, success with tobacco and potato

Metabolic Engineering and Industrial Products; Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway alkaloids, industrial enzymes biodegradable plastics, polyhydroxybutyrate, therapeutic proteins , lysosomal enzymes, antibodies, edible vaccines, purification strategies , olcosin portioning technology.

Molecular Marker-aided Breeding : RFLP maps , linkage analysis, RAPD markers, STS, Microsatellites, SCAR ( sequence characterised amplified regions). SSCP ( single strand conformational polymorphism), AFLP, QTL, map based cloning , molecular marker assisted selection. Arid and semi-arid plant biotechnology

Green House and Green-Home technology.

Books :

1. J.Hammond, P. McGarvey and V.Yusibov (Eds) Plant Biotechnology Springer Verlag, 2000.
2. T-J Fu. G. Singh and W.R. Curtis (Eds) : Plant Cell and Tissue Culture for the production of Food Ingredients kluwer Academics/Plenum Press 1999.
3. H.S. Chawla : Biotechnology in crop Improvement . International Book Distributing Company, 1998
4. R.J. Henry; Practical Application of Plant Molecular Biology, Chapman and Hall, 1997.
5. P.K. Gupta ; Elements of Biotechnology , Rastogi and C. Meerut , 1996

**BT – 306 BIOPROCESS ENGINEERING-II**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

Analysis of multiple interacting microbial populations.

Stability of recombinant cells

Physiology of immobilized cells

Growth and product formation by recombinant cells

Sensors for monitoring bioprocess parameters and biosensors, thermodynamics and stoichiometric aspects of microbial processes.

Engineering analysis of metabolic pathways.

Books :

Principles of Fermentation Technology by P.F. Stainbury and Whitaker 1995, Pergamon Press

Biochemical Engineering Fundamental by J.E. Bailey and D.F. Ollis McGraw Hill Publications.

**BT-308 BIOREACTOR DESIGN AND OPERATION.**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Introduction to bioreactors, modelling of bioreactors.  
 Concept of ideal and non-ideal bioreactor,  
 Residence time distribution  
 Stability analysis.  
 Homogeneous and heterogeneous reactions.  
 Kinetic analysis of bioreactors; fluidised bed, plug flow reactor, airlift, bubble column, continuous stirred tank reactor,  
 Unconventional bioreactors; hollow fibre reactor, membrane bioreactor, perfusion reactors.  
 Practical aspects regarding design and operation bioreactors.  
 Control of bioreactor ; physical , chemical and biological environment of the bioreactor.  
 PID controllers, Kilman filter stranded kilman filter, software sensor, fuzzy and neuro fuzzy controllers.

## Books :

- 1 Bioprocess Engineering Principles-P.M. Doran , 5<sup>th</sup> ed
- 2 Baily and Ollis-Biochemical Engineering
- 3 Chemical Reactor Engineering-Olavin Spiel
- 4 Principles of Microbe and cell cultivation-S.Hohn Prit
- 5 Chemical Engineering Vol 5 & 6 – Coulson & Richardson
- 6 Perr's Chemical Engineering Handbook, 7<sup>th</sup> ed, R.H. Perry and D.W. Green
- 7 Bioreactor Design and Product Yield Biotol. Mijnbeck, Oosterhuis Siebel Oths, Butterworth publications.
- 8 Biochemical Engineering Fundaments by J.E. Bailey and D.F. Ollis McGraw Hill Publication, 1986

**CE-216 ENVIRONMENTAL SCIENCE****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0****Unit 1 : The Multidisciplinary nature of environmental studies**

Definition, scope and importance

(2 Lectures)

Need for public awareness.

**Unit 2 : Natural Resources :****Renewable and non-renewable resources :**

Natural resources and associated problems.

- a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources : Use and over-Utilization of surface and ground water, floods, drought, conflicts and water, dams-benefits and problems.
- c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
- f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

**Unit 3 : Ecosystems**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.

- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

#### **Unit 4 : Biodiversity and its conservation**

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ conservation of biodiversity.

#### **Unit 5 : Environmental Pollution**

##### **Definition**

- Causes, effects and control measures of :-
  - a. Air pollution
  - b. Water pollution
  - c. Soil pollution
  - d. Marine pollution
  - e. Noise pollution
  - f. Thermal pollution
  - g. Nuclear hazards
- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

**Unit 6 : Social Issues and the Environment**

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people ; its problems and concerns. Case studies.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
  
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

(7 lectures)

**Unit 7 : Human Population and the Environment**

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV / AIDS
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

**Unit 8 : Field work**

- Visit to a local area to document environmental and river forest grassland hill mountain.
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

**BT-310 Down Stream Processing****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

**Introduction:** Characteristics of biosphere, An overview of Biosphere  
Separation of cells and other insoluble from fermented broth, filtration and centrifugation (batch, continuous). Designing of centrifuges for desired product of desired capacity.

**Cell Distraction: Physical methods-** osmotic shock, grinding with admixive solid shear, liquid shear.

**Chemical Methods:** Alkali Reagents, enzymatic Methods.

**Product Isolation:** Adsorption- desorption process, liquid-liquid extraction, aqueous two plane extraction, precipitation methods using ammonium sulphate organic solvents.

**Membrane base separation:** Microfiltration, Ultrafiltration dialysis, reverse osmosis.

Electrophoresis and chromatography principles of product purification: different electrophoresis techniques viz. isoelectric focusing, chromatographic techniques viz paper gel filtration, ion exchange, hydrophobic interaction, affinity, GLC, HPLC, Product Polishing crystallisation and drying.

**Books:**

1. Bailly & Ollis Biochemical Engg. – Academics Press.
2. H.Gunzler- Handbook of Analytic Techniques – Wiley publications
3. H.J. Rehm and G.Reed, Biotechnology- Vol, 3,4,5 verlar Publishers
4. Humphrey, Aiba and Miller, Biochemical Engg. – Academics Press.
5. Murray Moo- young comprehensive biotechnology, Vol. LI latest ed, Pergan Publishers.
6. Product Recovery in Bioproc. Technology, Heinemann, Butterworth Publication.
7. Stanburry and Whitteker, Principles of Fermentation Technology, Pergamon Press
8. Westermerier- Electrophoresis in Practice, Wiley Publications
9. Willard e. al, International Methods of Analysis- CBS publication
10. Wilson and Golding, A Biologist's Guide to Principles and techniques of Practical Biochemistry Cambridge university Press.
11. Principles of Fermentation Technology by P.F. Stanburry, A Whitekar and S. J Hall, 1997, Aditya Books (p) Ltd. New Delhi.
12. Biotechnology by Rehm and Reed Vol. 7(a)
13. Comprehensive Biotechnology By Murray Moo Young.

**BT-402 Major Project**

**Internal Marks: 60**  
**External Marks: 40**  
**Total Marks: 100**

**L T P**  
**0 0 8**

**BT 404 Enzyme Catalysed Organic Synthesis**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Biocatalysis- Definition of biocatalysis; chirality and biological activity advantages and disadvantages of biocatalysis over chemical catalysis.
2. Different types of biocatalysis; microbial, enzymatic and immobilized system of biocatalysis; current industrial biocatalysis with different enzymes.
3. Stereoselective biocatalysis for synthesis of chiral pharmaceutical intermediates such as synthesis of ACE inhibitors; definition, mode of action of inhibitors; recent developments, synthesis of anticholesterol drugs by biocatalytic routes, calcium channel blocking drugs, potassium channel openers, antiviral etc.
4. Immobilized enzymes for biocatalysis.
5. Industrial processes: comparing different approaches.

**Practical:**

Use of microorganisms/ enzymes for the synthesis of chirally pure compounds (drug/drug intermediates). Optimization of the reaction conditions. Product identification using different analytical techniques.

**Text Books**

1. Andreas S. Bommarium, Bettina R. Riebel. Biocatalysis: Fundamentals & Applications, Wiley VCH, 2004.
2. Lawrence P. Wackett and C. Douglas Hershberger Biocatalysis and Biodegradation: Microbial Transformation of Organic Compounds. ASM Press, Washington DC, 2001.
3. Stanley M. Roberts, Nicholas J. Turner, Andrew J. Willets, Michael K. Turner. Introduction to Biocatalysis: Using Enzymes and Microorganisms, Cambridge University Press, 1995.
4. Sheldon, R.A., Porskamp, P., and Ten Hoeve, W. Advantages and Limitations of Chemical Optical Resolution, in *Biocatalysis in Organic Synthesis*, Tramper, J., Van der Plas, H.C., and Linko, P. (Eds.) Elsevier, Amsterdam, 1985.

**BT-406 Project Management and Entrepreneurship****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Forms of Project Organization, project planning, project control, human aspects of project management, pre-requisites for successful project implantation, project management, international project management.
2. Network techniques for project management, development of project network, time estimation, determination of critical path, scheduling when resources and limited, PERT and CPM models, network cost-system.
3. Brief outline of social cost benefit analysis: rationale, UNIDO and Little Mirrlees approaches, UNIDO-IDCAS Manual, shadow prices and conversion factors.
4. Entrepreneurship: Need, scope and philosophy, Creativity and Entrepreneurship.
5. Entrepreneurship competencies and traits, factors affecting Entrepreneurship development.
6. Entrepreneurship- a function of innovation, the achievement motive in economic growth, theory of social change, family structure, migration & enterprise entrepreneurship.
7. Introduction to entrepreneurship and intrapreneurship. Barriers to entrepreneurship community and entrepreneurship function of entrepreneurship, classification of entrepreneurship.

**Text Books**

1. Peter F Drucker. Innovation and Entrepreneurship. Harper & Row, 1985.
2. Prasana Chandra- Projects: Preparation Appraisal and Superimplementation. Tata McGraw-Hill Co. Ltd.
3. J.D.West & F.K. Levy. A management guide to PERT/CPM, Prentice Hall, India.

**BT-408 Modelling and Simulation of Bioprocesses****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

1. Types of kinetic model; Data smoothing and analysis.
2. Mathematical representation of bioprocess; parameter estimation; numerical integration techniques; parameter sensitivity analysis; statistical validity.
3. Discrimination between two models. Physiological state markers and its use in the formulation of a structured model.
4. Development of compartment and metabolic pathway models for intracellular state estimation.
5. Dynamic simulation of batch, fed-batch steady and transient culture metabolism; Numerical optimization of Bioprocesses using Mathematical models.

**Practicals:**

To design mathematical models from the provided data.

**Text Books**

1. John Ingham, Irving J. Dunn, Elmar Heinzle & J.E. Prenosil. Chemical Engineering Dynamics: Modelling with PC Simulation (2<sup>nd</sup> Edition). Wiley-VCH, 2000.
2. Jonathan B. Snape, Irving J. Dunn Ingham & J.E. Prenosil. Dynamics of Environmental bioprocesses: Modelling and Simulation. Wiley-VCH, 1995.
3. Dieter Behrens & P. Kramer (Eds.). Bioreactors, Downstream Processing, Process and Reactor Modelling and Bioprocesses. Wiley-VCH, 1988.
4. Dunn. Biological Reaction Engineering. John Wiley & Sons Inc

**BT-410 Bioanalytical Techniques****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

1. Spectrophotometry (UV & Visible) and spectrofluorimetry, atomic absorption Spectrophotometry
2. Infrared and Raman spectroscopy. ORD and circular dichroism, Nuclear magnetic Resonance and Electron Spin Resonance spectroscopy, Magnetic Resonance Imaging.
3. Electron Microscopy: transmission and scanning electron microscopy, Tunneling electron microscopy, Atomic Force microscopy.
4. Crystallography and X-Ray diffraction, Electron diffraction, Neutron diffraction.
5. Radioisotope techniques: radiotracers GM Counter, Proportional and Scintillation counters, autoradiography, Mass spectrometry-GCMS and LCMS.

**Practical**

Identification of the provided sample using some of the spectroscopic techniques. Sample preparation for electron microscopy. Practical demonstration of the above mentioned techniques.

**Text Books:**

1. Keith Wilson & John Walker (Eds.). Principles and Techniques of Practical Biochemistry (5<sup>th</sup> Edition). Cambridge University Press, 2000.
2. P. Carmona, R. Navarro, A. Hernanz (Eds.). Spectroscopy of Biological Molecules: Modern Trends (1<sup>st</sup> Edition). Kluwer Academic Publishers, 1997.
3. Bernard Valeur. Molecular Fluorescence: Principles and Application (1<sup>st</sup> Edition). Wiley-VCH, 2001.
4. N. Rama Krishna, Lawrence J. Berliner (Eds.) Protein NMR for the Millennium (Biological Magnetic Resonance) (1<sup>st</sup> Edition). Plenum US, 2003.

**BT-412 Biomaterials****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

1. Molecular Design & Synthesis of biomaterials : Biodegradable Solid Polymeric Materials
2. Degradable materials with biological Recognition
3. Programmed/ Pulsed drug delivery & Drug Delivery in tissue Engg.,  
Biodegradable Polymers for Tissue Engg.
4. Hydrogel Biometrials: Structure & Physical Chemistry & Gel Swelling calcs,  
Physical Hydrogels, Polyelectrolyte hydrogels
5. Brannon Peppas theory of Swelling in Ionic Hydrogels, Ionisation calcs
6. Bioengg Applications of Hydrogels: Molecular imprinting & Drug Delivery,  
Hydrogels in drug delivery
7. Inorganic Biomaterials & Organic templating of inorganic materials & Bone Biomimesis
8. Molecular Devices - Molecular Switches in the cell – fibronectin as mechanical swift
9. Nano & Micro Particle Carriers
10. PEGylated surface model

**BT-414 Biomedical Engineering**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Introduction to biomedical engineering.
2. Dimensions, units and introduction to engineering analysis.
3. Forces, free-body diagrams & biomechanics.
4. Biomechanics, stress/strain. Biomechanics and pressure in the body.
5. Osmosis and the kidney.
6. Introduction to cell and tissue engineering & basic fluid dynamics. Blood, blood flow and the heart.
7. Bioinstrumentation and biosignals.
8. Biosignals and medical imaging. Basis of imaging: Neuroengineering : application of computed tomography, application , Fundamental of MRI, Optical biomedical diagnostics introduction to PET and SPECT, Imaging of gene expresses molecular imaging cardiac bioelectric.
9. Biomaterials, Ethics and professionalism in biomedical engineering.

**Text Books**

1. "Physics of the Body", JR Cameron, JG Skofronick, RM Grant, 2nd Edition, Medical Physics Publishing 1999.
2. "Introduction to Engineering Analysis", KD Hagen, Prentice Hall, 2001.
3. "Spreadsheet Tools for Engineers Using Excel", BS Gotfried, McGraw Hill, 2002.
4. "Introduction to Biomedical Engineering", J Enderle, S Blanchard, J Bronzino, Academic Press, 2000.

**BT-416. Introduction to Microelectromechanical systems and Nanabiotechnology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100****A. Microelectromechanical systems**

1. Introduction and Overview
2. Biosignal Transduction Mechanism
3. Electromagnetic Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms, Case Studies in Biomagnetic Sensors
4. Mechanical Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms, Case Studies in Microfluidic Devices
5. Chemical Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms
6. Optical Transducers: Basic Sensing Mechanisms, Basic Actuating Mechanisms
7. Ultimate Limits of Fabrication and Measurement, Recent Developments in BioMEMS

**B. Nano-biotechnology**

1. Overview of Nanotechnology : definition, history the new technological revolution, industrial and economic impact.
2. Introduction of Nanoscale physics : quantum mechanics, infinite potential well, energy, quantization, electron wave function, quantum confined Stark effect.
3. Low Dimensional Systems: Quantum Wells, Quantum Wires, and Quantum Dots, and their applications.
4. Properties of individual nanoparticles : optical properties, electronic properties
5. Carbon Nanostructures : Carbon Nanotubes and Buckey balls, their fabrication and applications
6. Magnetic Nanoparticles : properties and applications, spin valves, spintronics.
7. Nanofabrication Techniques: Self-Assembly and Catalysis, electron-beam, lithography, Template based fabrication.
8. Nanobiotechnology : Nanoscale biological materials, DNA detection, applications of nanoparticles in diagnosis and therapy.

**Text Books**

1. David S. Goodsell. Bionanotechnology: Lessons from Nature. (1<sup>st</sup> Edition) Wiley-Liss. 2004.
2. Bharat Bhushan. Handbook of Nanotechnology (1<sup>st</sup> Edition). Springer Verlag, 2004.

Christof M. Niemeyer & Chad A. Mirkin (Eds.). Nanobiotechnology: Concepts, Applications and Perspectives, 2004

**BT-418 Environmental and Occupational Toxicology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Dose-Response
2. Absorption
3. Distribution
4. Biotransformation
5. Excretion
6. Toxicokinetics
7. Biochemical Mechanisms of Toxicity
8. Mechanism of Signal Transduction
9. Cell Death & Apoptosis
10. Carcinogenesis
11. Genetic Toxicology Introduction, Short term assays for detecting genetic toxicology(in vitro and in vivo with examples of AMES, SOS, Cytogenetic Dominant lethal assays)
12. Toxicogenomics
13. Ecogenetics/Env Epidemiology
14. Role of Proteomics in toxicology
15. Role of Metabonomics in toxicology
16. Risk Assessment Handouts
17. Biotech/Regulatory Toxicology

**Text Books**

The Basic Science of Poisons: Casarett and Doull's Toxicology 2003 CD Klaassen, 6th Edition,

<b>BT-420 Advances in Drug design and drug delivery systems and Pharmacogenomics</b>	
<b>Internal Marks: 40</b>	<b>L T P</b>
<b>External Marks: 60</b>	<b>3 1 0</b>
<b>Total Marks: 100</b>	

1. Cell culture basics: cell lines, media, growth and culture characteristics, scale-up.
2. Animal cell culture products and their therapeutic potential: human biologicals, recombinant proteins, viral vaccines, monoclonal antibodies, importance of glycosidation for bioactivity.
3. Toxicity testing by in vitro assays.
4. The pharmaceutical use of metal ion chelating drugs.
5. An evaluation of the effectiveness of EDTA Chelation therapy@ as judged by the current scientific literature and a comparison with claims that are popularly made for this therapy.
6. The Newtonian basis of molecular modeling as it applies to the design of new drugs.
7. The design of several HIV protease inhibitors in treating AIDS and their interaction with their protein targets using molecular modeling.
8. Seeking bioactive moieties from natural sources.
9. Structure modification of natural therapeutic agents.
10. Modifying natural responses.
11. Chemical approaches to site-specific delivery of therapeutic entities.
12. Pharmacognosy for the 21<sup>st</sup> century. Pharmacogenomics Genomics & Proteomics: Concepts DNA Microarray Technology, Statistical Analysis of DNA Microarrays Bioinformatics, Cluster Analysis MIAME & LIMS, Development of genomic and proteomic based Individualized drugs.
13. Biotechnological Pharmaceutical products : FDA approved, marketed, and in clinical trial
14. Professional and legislative issues related to therapeutic biotechnology.
15. Pharmacokinetics/ Pharmacodynamics in Drug Development.
16. HPLC Application in Drug Design and Development
17. Rational design of novel and optimized dosage forms: influence of physicochemical and biological factors.
18. Oral controlled release: formulation/technology design and development.
19. Transdermal drug delivery.
20. Formulation Development for Peptide and Protein Candidates.
21. Drug delivery technologies like – nanoparticles, microspheres and liposomes and Future Directions

#### **Text Books**

1. Burger's Medicinal Chemistry, John Wiley & Sons, Inc., New York, 1994, Vols. 1-3.
2. *Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 10<sup>th</sup> Edition, Delgado and Remers WA, Eds. New York, Lippincott-Raven, 1998.
3. Applied Biopharmaceutics and Pharmacokinetics 4<sup>th</sup> Edition Leon Shargel and Andrew Yu, Appleton & Lange, Stamford CT, 1999 Clinical Pharmacokinetics 3<sup>rd</sup> Edition, M. Rowland and T. Tozer, Williams and Wilkins,
4. Problems associated with delivery of larger molecules, delivery consideration of peptide and protein through various routes of drug administration
5. Gene therapy and gene delivery
6. Drug targeting and biotechnology.