Proposed Syllabus
For
M. Tech. Biotechnology Course
Of
M.D. University
(Board of studies in Engineering & Technology)
(2015-onwards)

M.D.UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATION
1st YEAR M. TECH. IN BIOTECHNOLOGY, SEMESTER I
EFFECTIVE FROM THE SESSION 2015-16

S.No	Course No.	Subject	Teaching Schedule	Examination Schedule				
				Marks for		Credits for		
			L-T-P	Exam	Sess	Exam	Sess	Total
1.	BT –501	Engineering Principles in Biotech	4-0-0	100	50	4	2	6
2.	BT – 503	Advanced Molecular Biology	4-0-0	100	50	4	2	6
3.	BT – 505	Industrial Biotechnology	4-0-0	100	50	4	2	6
4.	BT – 507	Genetic Engineering	4-0-0	100	50	4	2	6
5.	BT- 509	Elective I	4-0-0	100	50	4	2	6
6.	BT – 511	Biotech Lab-I	0-0-3	50	50	2	2	4
7.	BT – 513	Biotech Lab. II	0-0-3	50	50	2	2	4
	TOTAL			**600**	**350**	**24**	**14**	**38**

List of Electives I

S. No.	Code	Subject
1	BT –515	Biosensors
2	BT – 517	Genomics & Proteomics
3	BT – 519	Environmental Biotechnology
4	BT – 521	BioseprationEngineering

NOTE:

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus however the examiner will evaluate the performance of the students in the theory course finally by assigning one of the grades out of A+, A, B, C, D, E, and F. Examination of practical courses shall also be evaluated on the basis of grades.

2. The Sessionals of Theory and Practical courses shall also be evaluated on the basis of above grades.

3. For grading system is defined at the end of the scheme of studies and examinations.

M.D.UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATION
1st YEAR M. TECH. IN BIOTECHNOLOGY, SEMESTER II
EFFECTIVE FROM THE SESSION 2015-16

S.No	Course No.	Subject	Teaching Schedule L-T-P	Examination Schedule				
				Marks for Exam	Sess	Credits for Exam	Sess	Total
1.	BT –502	Bioinformatics	4-0-0	100	50	4	2	6
2.	BT – 504	Immunotechnology	4-0-0	100	50	4	2	6
3.	BT – 506	High Resolution Techniques in Biotech	4-0-0	100	50	4	2	6
4.	BT – 508	Elective II	4-0-0	100	50	4	2	6
5.	BT- 510	Elective III	4-0-0	100	50	4	2	6
6.	BT – 512	Biotech Lab-III	0-0-3	50	50	2	2	4
7.	BT – 514	Biotech Lab. IV	0-0-3	50	50	2	2	4
	TOTAL			**600**	**350**	**24**	**14**	**38**

List of Electives II

S. No.	Code	Subject
1	BT –516	Food Processing Engineering
2	BT – 518	Protein Engineering
3	BT – 520	Animal Biotechnology
4	BT – 522	Fermentation Technology

List of Electives III

S. No.	Code	Subject
1	BT – 524	Bioreaction Engineering
2	BT – 526	Reproductive Genetics
3	BT – 528	Clinical Genetics &Counseling
4	BT – 530	Plant Metabolite Engineering
5	BT – 532	Renewable Energy Technology

NOTE:

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus however the examiner will evaluate the performance of the students in the theory course finally by assigning one of the grades out of A+, A, B, C, D, E, and F. Examination of practical courses shall also be evaluated on the basis of grades.

2. The Sessionals of Theory and Practical courses shall also be evaluated on the basis of above grades.

3. For grading system is defined at the end of the scheme of studies and examinations.

M.D.UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATION
2nd YEAR M. TECH. IN BIOTECHNOLOGY, SEMESTER III
EFFECTIVE FROM THE SESSION 2015-16

S.No	Course No.	Subject	Teaching Schedule	Examination Schedule				
				Marks for		Credits for		
			L-T-P	Exam	Sess	Exam	Sess	Total
1.	BT –601	Advanced Plant Biotechnology	4-0-0	100	50	4	2	6
2.	BT – 603	Advanced Biochemical Engg.	4-0-0	100	50	4	2	6
3.	BT – 605	Elective IV	4-0-0	100	50	4	2	6
4.	BT – 607	Biotech Lab-V	0-0-3	50	50	2	2	4
5.	BT- 609	Biotech Lab. VI	0-0-3	50	50	2	2	4
6.	BT – 611	Seminar I	0-0-2	---	50	---	2	2
7.	BT – 613	Dissertation Phase-I	0-0-6	---	100	---	4	4
	TOTAL			**400**	**400**	**16**	**10**	**32**

List of Electives IV

S. No.	Code	Subject
1	BT –615	Biotech Resource Planning & IPRs
2	BT – 617	Biopharmaceutical Tech
3	BT – 619	Process Control & Instrumentation
4	BT – 621	Process Modeling& Simulation
5	BT- 623	Stem Cells in Health Care
6	BT – 625	Nanotechnology
7	BT – 627	Biomaterials
8	BT –629	Clinical Trials & Bioethics

NOTE:

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus however the examiner will evaluate the performance of the students in the theory course finally by assigning one of the grades out of A+, A, B, C, D, E, and F. Examination of practical courses shall also be evaluated on the basis of grades.

2. The Sessionals of Theory and Practical courses shall also be evaluated on the basis of above grades.

3. For grading system is defined at the end of the scheme of studies and examinations.

M.D.UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATION
2nd YEAR M. TECH. IN BIOTECHNOLOGY, SEMESTER IV
EFFECTIVE FROM THE SESSION 2015-16

S.No	Course No.	Subject	Teaching Schedule	Examination Schedule		
				Marks for	Credits for	
			L-T-P	Exam Sess	Exam Sess	Total
1.	BT – 602	Seminar II	0-0-2	--- 50	---- 2	2
2.	BT – 604	Dissertation Phase-II Final	0-0-26	500 100	20 4	24
	TOTAL			**500 150**	**20 6**	**26**

NOTE:

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus however the examiner will evaluate the performance of the students in the theory course finally by assigning one of the grades out of A+, A, B, C, D, E, and F. Examination of practical courses shall also be evaluated on the basis of grades.

2. The Sessionals of Theory and Practical courses shall also be evaluated on the basis of above grades.

3. For grading system is defined at the end of the scheme of studies and examinations.

M.D.UNIVERSITY, ROHTAK
SCHEME OF GRADING SYSTEM
M. TECH. IN BIOTECHNOLOGY,(SEMESTER I- IV)

The faculty will evaluate academic performance of the students from 10 point scale and the award of the grades based upon marks obtained out of 100 shall be made as follows:

Marks		Grade		Marks
85	≤	A+	≤	100
75	≤	A	≤	85
65	≤	B	≤	75
50	≤	C	≤	65
40	≤	D	≤	50
20	≤	E	≤	40
00	≤	F	≤	20

Further level of performance of the students will be evaluated as below:

A+	Excellent	10
A	Very Good	9
B	Good	8
C	Average	6
D	Pass	4
E	Require to improve	2
F	Repeat	0

To obtain the D grade every student must get 40% mark sin each subjects in the end of semester examination.

Student who earns an E grade in the course shall have to re-appear in that course again when it is offered.

M. Tech. 1st SEMESTER (Bio– Tech.)
Engineering Principles in Biotechnology
BT –501

L T **Theory : 100 Marks / 4 credits**
40Sessional:50 Marks / 2 credits
Total : 150 Marks / 6 credits
Time : 3 Hrs.

Unit I

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.

Unit II

Energy and Material Balances

Unit operations and unit processes: historical and more recent developments in biochemical engineering; Process variables and degrees of freedom; Differential and integral balances.

Unit III

Probability: Definition of Sample Space, Event, Event Space, Conditional Probability, Additive and Multiplicative law of Probability, Baye's Law theorem, application in biotechnology.

Presentation and analysis of data: Statistical analysis, mean, mode/ median/standard deviation etc., Histogram, Scatter plot, Distributions (binomial, poission and normal), Tests of significance (x2 and t) regression and correlation, Analysis of variance.

Unit IV

Introduction to transport phenomena: 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)

Unit V

Heat & Mass 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 equipment. Unsteady state heat transfer, Radiation.

Text/ Reference

1. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)
Advanced Molecular Biology
BT –503

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Genome organization

Organization of bacterial genome; Structure of eukaryotic chromosomes; heterochromatin and Euchromatin; DNA reassociation kinetics(Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting; DNA methylation & Imprinting

Unit II

DNA Structure; Replication; Repair & Recombination

Structure of DNA - A-,B-, Z- and triplex DNA; Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous; Site specific recombination; Chi sequences in prokaryotes

Unit III

Prokaryotic & Eukaryotic Transcription

Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, ara, his, and gal operons; Transcriptional control in lambda phage; Transcript processing; Processing of tRNA and rRNAEucaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and post-transcriptional gene silencing

Unit IV

Post Transcriptional Modifications

Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA.

Translation & Transport

Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; IsoacceptingtRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications; Genetic code in mitochondria; Transport of proteins and molecular chaperones; Protein stability; Protein turnover and degradation

Unit V

Mutations; Oncogenes and Tumor suppressor genes

Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frameshift mutations; Physical, chemical and biological mutagens; Transposition - Transposable genetic elements in prokaryotes and eukaryotes; Mechanisms of transposition; Role of transposons in mutation; Viral and cellular oncogenes; Tumor suppressor genes from humans; Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins; Activation of oncogenes and dominant negative effect; Suppression of tumor suppressor genes.

Text/References:

1. Benjamin Lewin, Gene IX, 9th Edition, Jones and BarlettPublishers, 2007.
2. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz &A.M.Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
3. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)
Industrial Biotechnology
BT –505

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit-I

Fundamentals of Industrial Microbiology: Introduction, objectives and applications.Cultivation & Maintenance of Microorganism: Different types of culture medium; C/N/P balance and design of culture medium. Substrates for industrial microbial processes.Industrially important microbes: Isolation, preservation and improvement of industrially important microorganisms, selection of mutants, use of rDNA technology

Unit-II

Process technology for the Production of various Products:Primary metabolite : ethanol, , citric acid, vinegar and amino acid. Production of alcoholic beverages -wine and beer. Microbial production of industrial enzymes: Cellulase, glucose isomerase and lipase.

Unit-III

Production of secondary metabolites: Antibiotics e.g. penicillin, tetracycline
Process technology for the production of microbial biomass: Introduction, conventional protein sources, substrates, Microorganisms used, SCP from CO_2, Carbohydrates, Hydrocarbons

Unit-IV

Microbial Transformations: Transformation of alkaloids, steroids, carotenids andsterols.Transformation of non-steroidal compounds and pesticides**.**Applications of microbes for designing vaccines and drugs.Production of rDNA products including DNA vaccines, Taq polymerase

Unit-V

Uses of microbes in -biosensors, fuel cells, cancer therapy, Biofertilizer Bioremediation,Paper industry, Biohydrometallurgy and Biomineralizationand coal solubilization.

Text/Reference Books:

1. Industrial Microbiology.Casida Jr., L.E. (1968) New Age International (P)Ltd. New Delhi.
2. Prescott& Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.

3Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Crueger, W. and Crueger, A. (2000) Panima Publishing Corporation, New Delhi.
4Enzymes: Biochemistry, Biotechnology, Clinical chemistry. Palmer, T. (2000) Horwood publishing Colphon.

5 Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press WashingtonD.C.

6 Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. (1993) Tata McGraw Hill, New Delhi
7 Microbiology: Prescott et al., 2003, 5th edition, McGraw Hill, USA.

8 Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
9 Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates,
1990.
10 M.T. Madigan and J.M. Martinko, Brock Biology ofMicroorganisms, 11th Edition, Pearson Prentice-Hall, 2006.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Genetic Engineering
BT –507

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Basics Concepts

DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay; DNaseIfootprinting;

Unit II

Cloning Vectors

Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo& retroviral vectors; Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Baculovirus vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors

Unit III

Cloning Methodologies

Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expressioncloning; Jumping and hopping libraries; Southwestern and Farwestern cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression

Unit IV

PCR and Its Applications

Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)

Unit V

Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.

Text/References:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A LaboratoryManual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New EnglandBiolab etc.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)

Biosensor

BT –515

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT I

History & scope, definition, principle of biosensors; Classification of biosensors based on transducer & recognition element. Components & basic designing of biosensor.

UNIT II

Enzyme biosensors: enzyme immobilization technology & electrode fabrication technology and its principle; Type of enzyme electrodes; recent developments in enzymatic sensors and commercialization.

UNIT III

Immunosensors: & fabrication technology and its principle; DNA sensors and its principle; application of immunosensors& DNA biosensor technology. Gold electrode and gene chips.

UNIT IV

Nanotechnology and biosensors; Carbon nanotubes, Gold nanoparticales, conducting polymers and electrode designing.

UNIT V

Study of recent development on glucose, lactate, urea, cholesterol, HPV and their commercial and future prospects.

Text/Reference Books:

1. *Commercial Biosensors* Graham Ramsay, John Wiley Publishers

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)
Genomics & Proteomics
BT –517

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Introduction: Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA-mitochondrial, chloroplast; DNA sequencing principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools forgenome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree Analysis-physical and genetic mapping.

Unit II

Genome sequencing projects: Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.

Unit III

Proteomics: Protein analysis (includes measurement of concentration, aminoacid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution isoelectricfocusing; Peptide fingerprinting; LC/MS-MS for identification of proteins andmodified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.

Unit IV

Pharmacogenetics: High throughput screening in genome for drug discovery identification of gene targets, Pharmacogenetics and drug development

Unit V

Functional genomics and proteomics: Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein *in situ* arrays; Structural proteomics

Texts/References:

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
2. Brown TA, Genomes, 3rd Edition. Garland Science 2006
3. Campbell AM &Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
4. Primrose S &Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)
Environmental Engineering
BT –519

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT I

Introduction to Environment: Environment , pollutant and, environmental pollution (Water, soil and air) noise and thermal pollution, their sources and effects.

Role of Biotechnology in Environment Protection: Introduction and current status of biotechnology in environment protection and its future prospects.

UNIT II

Bioremediation : What is bioremediation? Types of bioremediation, bioaugmentation for bioremediation. Bioreactors for remediation processes. Applications of bioremediation

Removal of Specific Pollutants: Sources of heavy metal pollution, microbial systems for heavy metal accumulation, biosorption, bioleaching.

UNIT III

Bioreactors for Waste Water Treatment: Biological processes for industrial effluent treatment, aerobic biological treatment, anaerobic biological treatment, periodic biological reactors, membrane bioreactors, use of immobilized enzymes and microbial cells.

Unit-IV

Solid waste management: landfills, composting, earthworm treatment, recycling and processing of organic residues.

Biotechnology for Hazardous Waste Management : Xenobiotic compounds, recalcitrance, hazardous wastes, biodegradation of xenobiotics, biological detoxification, biotechnological management of hazardous wastes.

Restoration of degraded lands : Restoration through microorganisms, Casuarinas for tropical reforestation on adverse sites, development of stress tolerant plants, use of mycorrhizae in reforestation. Organic farming and use of microbes for improving soil fertility, reforestation of lands contaminated with heavy metals.

Unit-V

Biotechnology for Waste Treatment of Food and Allied Industries: Biological treatment, methods, SCP and biomass from waste and distillery industry.

Novel Methods for Pollution Control : Vermitechnology, waste water treatment using aquatic plants, root zone treatment. Aiming for biodegradable and ecofriendly products.

Microbiology and Biochemistry of Waste Water Treatment: Biological treatment, impact of pollutatnts on biotreatment, cell physiology and important microorganisms, plasmid borne metabolic activities, bioaugmentation, packaged microorganisms, use of genetically engineered organisms.

Text/Reference Books:

1. Waste water Engineering Treatment, Disposal and Reuse. Metcalf & Eddy (1991) McGraw Hill.
2. Environmental Biotechnology. Forster, C. F and. Wase, D. A. J. (1987) Ellis Horwood Halsted Press.
3. New Processes of Waste water treatment and recovery. G. Mattock E.D. (1978) Ellis Horwood.
4. Biochemical Engineering Fundamentals 2nd ed. Bailey, J. E. and Ollis, D. F. (1986) MacGraw Hill. New York.
5. Environmental Biotechnology. Jogdand, S.N. (1995) Himalaya Publishing House, New Delhi.
6. Comprehensive Biotechnology (Vol. 1-4) Young Murray Moo (Ed.) (1985) Elsever Sciences.
7. Standard Method for Examination of water & waste water 14th Ed. (1985) American Public Health Ass.
8. Environmental Biotechnology by Alan Scragg (1999); Longman.

9. An Introduction to Environmental Biotechnology by Milton Wainwright (1999): KluwerAcademic Press.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)
Bioseperation Engineering
BT –521

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Principles of enzyme catalysis

Proteins as enzymes; Michaelis-Menten kinetics; Kinetics andStatistics; Inhibition; Effect of pH and temperature; Enzymology;Immobilized enzymes: methods, mass transfer considerations;Industrial enzymes

Unit II

Microbial growth

Introduction to metabolism; Nutrient transport; Glycolysis; TCAcycle and other pathways; Control of metabolism; Factors affectingmicrobial growth; Stoichiometry: mass balances; Stoichiometry:energy balances; Growth kinetics; Measurement of growth.

Unit III

Bioreactors

Introduction to bioreactors; Batch and Fed-batch bioreactors,Continuous bioreactors; Immobilized cells; Bioreactor operation;Sterilization; Aeration; Sensors; Instrumentation; Culture-specificdesign aspects: plant/mammalian cell culture reactors.

Unit IV

Bioseparations

Biomass removal; Biomass disruption; Membrane-basedtechniques; Extraction; Adsorption and Chromatography

Ultra-filtration membrane processes – Types of equipment, flux equation, effects of processing variables

Supercritical fluid extraction

Unit V

Industrial Processes and Process economics

Description of industrial processes; Process flow sheeting;Process economics

Text/Reference Books:

1. Bioprocess engineering Basic concepts M.A Shuler, FikiretKargi, PHI, India
2. Coulson & Richardson's Chemical Engineering- Volume 3 (Chemical and Biochemical Reactors and processcontrols) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)

Biotechnology Lab-I –511

L	T	P	
0	0	3	**Exam. : 50 Marks / 2 credits**
			Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I work to be carried out as per BT-505.

M. Tech. 1st SEMESTER (Bio– Tech.)

Biotechnology Lab-II –513

L	T	P	
0	0	3	**Exam. : 50 Marks / 2 credits**
			Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I1 work to be carried out as per BT-503 and BT-507.

M. Tech 2nd SEMESTER (Bio– Tech.)
Bioinformatics
BT –502

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Sequence-alignment related problems.

Sequence databases; Similarity matrices; Pairwise alignment;BLAST; Statistical significance of alignment; Sequence assembly;Multiple sequence alignment; Clustal; Phylogenetics: distancebased approaches, maximum parsimony.

Unit II

Pattern analysis in sequences

Motif representation: consensus, regular expressions; PSSMs;Markov models; Regulatory sequence identification using Meme;Gene finding: composition based finding, sequence motif-basedfinding.

Units III and IV

Structure-related problems

Representation of molecular structures (DNA, mRNA, protein),secondary structures, domains and motifs; Structure classification(SCOP, CATH); Visualization software (Pymol, Rasmol etc.);Experimental determination of structures (X-ray crystallography, NMR); Structure databases; Secondary structure prediction; RNAstructure prediction; Mfold; Protein structure prediction bycomparative modelling approaches(homology modelling, threading);Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches, side-chain packing; Energyminimization; Molecular dynamics; Rosetta; Structure comparison(DALI, VAST etc.); CASP; Protein-ligand docking; Computer-aideddrug design (pharmacophore identification); QSAR; Protein-Proteininteractions

Unit V

System-wide analyses:

Transcriptomics: Microarray technology, expression profiles, dataanalysis; SAGE; Proteomics: 2D gel electrophoresis; MassSpectrometry; Protein arrays; Metabolomics: 13C NMR basedmetabolic flux analysis.

Texts/References:

1. David W. Mount. Bioinformatics: Sequence and Genome Analysis2nd Edition, CSHL Press, 2004.
2. A. Baxevanis and F. B. F. Ouellette, Bioinformatics: a practicalguide to the analysis of genes and proteins, 2nd Edition, JohnWiley, 2001.
3. Jonathan Pevsner, Bioinformatics and Functional Genomics, 1stEdition, Wiley-Liss, 2003.
4. P. E. Bourne and H. Weissig. Structural Bioinformatics. Wiley.2003.
5. C. Branden and J. Tooze, Introduction to Protein Structure, 2ndEdition, Garland Publishing, 1999.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 1st SEMESTER (Bio– Tech.)

Immunotechnology

BT –504

L	T	
4	**0**	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT I

Innate and acquired immunity, cells and organs of the immune system, Primary and secondary lymphoid organs, humoral and cell mediated immune response.

UNIT II

Antigens, antigenic determinants: Isotype, allotype&idiotype; Immunoglobulins : structure and function, Organization and expression of immunoglobulin genes, Generation of Ab. Diversity, class switching, and Ab. Engg.

UNIT III

Major histocompatibility complex, Peptide binding by class I and class II molecules, Ag. Processing presentation, T-Cell receptor, T-cell maturation, activation &differtiation , Positive & negative selection, signalling pathways.

UNIT IV

Cytokines properties, The complement system, Role of T- helper cells in cytokine production, cell mediated effector responses. Hypersensitive reaction, auto immunity, and immune response to infectious disease, tumor immunity,

UNIT V

Tissue and organ transplant , vaccines & peptide vaccines, Monoclonal Ab, Hybridomatechonology, ELISA, Radio immunoassay, immunoprecipitin reactions.

Text/Reference Books:

1.Kuby,s Immunology 4th edition) R.A. Goldsby ,T. J. Kindt, B.A. Osborne, W.H.Freeman& company, New.York.

2.Essential Immunology (10th edition), IvonRoitt, Peter Delves, Blackswell, Scientific Publications. Oxford.

3.Fundanental of immunology . Paul W.E.(Eds) Raven press ,New York.

4. Immunology by Presscot .

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
High resolution Techniques in Biotech.
BT –506

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I
Applications of spectroscopic and other techniques to the study of biomolecules: UV-Vis spectroscopy, Circular dichroism, Fluorescence, NMR, Mass, IR and Raman spectroscopy, X-Ray diffraction.

Unit II
Cellular Imaging Techniques: Microscopy: Phase contrast, Fluorescence, Atomic Force and confocal.

Unit III
Biophysical techniques to purify and study proteins. Dialysis, salting out and precipitaion by organic solvents, Ion exchange, gel filtration, reversed phase, affinity chromatography, ultracentrifugation.

Unit IV
Gel electrophoresis. Analysis of Proteins: Electrophoretic separation of proteins (single dimension native and denaturing gels, 2D and digital electrophoretic analysis), detection (staining, blotting and immuno-detection, ELISA, RIA) and purification of proteins (various chromatography, HPLC, immunoprecipitation), and specialized applications (in vitro synthesis of protein, labeling, microsequence analysis,

Unit V
Need for high resolution separation for value added biotechnological products; Difficulties with traditionalmethodologies; Affinity precipitation and partitioning; MF/UF/NF for high resolutionseparation. Applications of radioisotopes in advanced research.

Text/Reference Books:
1.Biological Spectroscopy: Campbell and Durek.
2.Physical Biochemistry, 2nd edition by D.Friefelder, W.H.Freeman and company U.S.A.
3.Introduction to instrumental analysis : Robert. D. Braun (1987). McGraw Hill International Edition, Chemistry Series.
4.Analytical Chemistry for technicians : John kenkel (1994), Lewis Publishers.Boca Raton

5.Principles and techniques of Practical Biochemistry:K.Wilson and J.Walker (1994), Cambridge University Press, Cambridge

.**6**. **BophysicalChemistry: Principle and Techniques**,2nd eddition by A.Upadhyay, K.Upadhyay and N.Nath.(1998).Himalya Publication House.Delhi.

7. **Physical Biochemistry**, 2nd edition by K.E.Vanholde (1985), Prentice Hall Inc.,New Jersey.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Food Processing Engineering
BT –516

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT I

Status of food processing industry in India and abroad; prospects and constraints in development of Indian food industry. Basic principles involved in fermentation, Technological aspects of pickled vegetables like sauerkraut, cucumbers, Technology of wine, beer and distilled alcoholic beverages, defects in alcoholic beverages.

UNIT II

Definition, classification and technologies of fabricated and formulated, foods and their nutritional aspects. Food additives, including stabilizers, emulsifiers, antioxidants, preservatives, etc. for formulated foods.

Strategic interventions to minimize post harvest losses including vapour heat treatment, wax coating, chemicals, etc.

UNIT III

Principles of chilling & refrigeration storage of foods, quality changes in cold stored products, controlled and modified atmospheric storage. Freezing of foods, principle and equipments for freezing, defects in frozen foods, re-crystallization.

UNIT IV

Application of heat energy to foods for preservation and processing, concept of drying rate of foods, industrial drying processes of foods; changes during drying, advanced drying processes (Freeze drying, infra red drying and microwave drying), Canning of fruits & vegetables, unit processes involved in canning.

UNIT V

Advances in milling of rice (solvent extractive milling) and Turbo milling of wheat. Developments in manufacturing processes for bakery products such as breads; biscuits; cake etc; changes during processing of bakery products. Application of enzymes in food processes like enzymes juice extraction, juice clarification, in bread manufacture, , ice cream manufacture, etc. Newer concepts in food processing including organic foods, processing oforganic raw material, genetically modified foods.

Text/Reference Books

Fellows PJ. 2000. *Food Processing Technology: Principles and Practices*.2nd Ed. CRC-Woodhead Publ.

Fennema CR. 1975. *Principles of Food Science.* Part II. *Physical Principlesof Food Preservation.* Marcel Dekker.

Guy R. 2001. *Extrusion Cooking: Technologies and Applications*. CRCWoodheadPubl.

Honseney RC. 1986. *Cereal Science and Technology*. AmericanAssociation of Cereal Chemists, St. Paul, Minnesota.

Hui YH, Meunix-Goddick L, Hansen AS, Josephsen J, Nip WK, StanfieldPS &Toldra F. 2004. *Handbook of Food and BeverageFermentation*. Marcel Decker.
Hui YH, Nip WK, Rogers RW & Young DA. 2001. *Meat Science andApplication*. Marcel Decker.
Norman W &Desrosier IN. 1987. *The Technology of Food Preservation*.4th Ed. CBS Publ.
Penfield MP & Campbell AM. 1990. *Experimental Food Science*. 3rd Ed.Academic Press.
Ramaswamy H &Marcotte M. 2006. *Food Processing: Principle andApplication*. Taylor & Francis.
Vangarde JS & Woodburn M. 1994. *Food Preservation and Safety:Principles and Safety*. IowaStateUniversity Press, Iowa

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Protein Engineering
BT –518

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Protein engineering – definition, applications; Features or characteristics of proteins that can be engineered (definition and methods of study) – affinity and specificity; Spectroscopic properties; Stability to changes in parameters as pH, temperature and amino acid sequence, aggregation propensities, etc.

Unit II

Methods of measuring the stability of a protein; Spectroscopic methods to study physicochemical properties of proteins: far-UV and near-UV CD; Fluorescence; UV absorbance; ORD; Hydrodynamic properties–viscosity, hydrogen-deuterium exchange;
Brief introduction to NMR spectroscopy – emphasis on parameters that can be measured/obtained from NMR and their interpretation

Unit III

Forces stabilizing proteins – Van der waals, electrostatic, hydrogen bonding and weakly polar interactions, hydrophobic effects; Entropy – enthalpy compensation; Experimental methods of protein engineering: directed evolution like gene site saturation mutagenesis; Module shuffling; Guided protein recombination, etc., Optimization and high throughput screening methodologies like GigaMetrix, High throughput microplate screens etc., Application to devices with bacteriorhodopsin as an example; Engineering antibody affinity by yeast surface display; Applications to vaccines.

Unit IV

Computational approaches to protein engineering: sequence and 3D structure analysis, Data mining, Ramachandran map, Mechanism of stabilization of proteins from psychrophiles and thermophiles vis-à-vis those from mesophiles; Protein design.

Unit V

Case studies

Texts/References:

1. Edited by T E Creighton, Protein structure: A practical approach, 2nd Edition, Oxford university press, 1997.
2. Edited by T E Creighton, Protein function. A practical approach, 2nd Edition, Oxford university press, 1997.
3. Edited by T E Creighton, Protein function. A practical approach. Oxford university press. 2004.
4. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands 1998.
5. Mueller and Arndt., Protein engineering protocols, 1st Edition, Humana Press, 2006.
6. Ed. Robertson DE, Noel JP, Protein Engineering Methods in Enzymology, 388, Elsevier Academic Press, 2004.
7. J Kyte, Structure in protein chemistry, 2nd Edition, Garland publishers, 2006.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Animal Biotechnology
BT –520

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT I

Primary culture, secondary culture, sub-culturing, Cell lines, cloning & selection. Media, serum free media (advantage & disadvantages).

UNIT II

Large scale culturing, Preservation and maintenance of animal cell lines. Cryo preservation, Cell culture products, Hybridoma technology,

UNIT III

Gene transfer (transfection) methods, Embryonic stem cell transfer, *In Vitro* fertilization and embryo transfer. Gene therapy, Animal cloning & ethical issues.

UNIT IV

Tissue and organ transplant, vaccines & peptide vaccines, Proteins as therapeutic agents, Applications, delivery and targeting of therapeutic proteins. Engineering human interferons and human growth hormones. Enzymes as therapeutic agents: Use of genetically engineered DNase I and alginate Lyase for treatment of Cystic Fibrosis

UNIT V

AIDS and its clinical focus; Cancer immunotherapy & vaccines; Experimental Animal models, Genetic diagnostic methods and microarray technology.

Text/Reference Books:

1. *Molecular Biotechnology* by Old and Primrose.

2. *Molecular Biotechnology: Principles and Applications of recombinant* DNA By Bernard R. Glick, Jack. J. Pasternak, 2nd Edition. ASM press WashingtonDC.

3. *Animal Cell biotechnology:* R.E. Spier and J.D Griffiths (1988) Academic press.

4. *Living resources for Biotechnology, Animal cells:* A. Doyle, R. Hay and B.E. Kirsop (1990), Cambridge University Press, cambridge.

5. *Animal Biotechnology:*Murray Moo-Young (1989), Pergamon Press, Oxford

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Fermentation Technology
BT –522

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I
Fermentation: History, Introduction, application, and a Skill for the Future, Fermentation Equipment Selection: Laboratory Scale Bioreactor, Modes of Fermenter Operation, construction of fermenter. In situ and ex-situ sterilization process in fermenters.

Unit II
Non ideality and RTD in bioreactors; stability analysis; analysis of multiple interacting microbial populations; The Design and Preparation of Media for fermentation, Preservation of Cultures for Fermentation Processes, Design Considerations for Production of Membrane Proteins, stability of recombinant cells in bioreactors.

Unit III
Physiology of immobilised cells; packedbed bioreactors; fluidized-bed bioreactors; air lift bioreactors; bubble column bioreactors; immobilized enzyme bioreactors; special reactors for animal and plant cells; integrated systems of bioreaction and bioseparation.

Unit IV
Modelling and the Kinetics of Biological Activity in Fermentation Systems, Scale Up and Scale Down of Fermentation Processes, On-line, In-situ, Measurements within Fermenters, SCADA Systems for Bioreactors, Basic Statistical Analyses in Fermentation.

Unit V
Major unit operations and unit processes in fermentation based industries. Case study: failure of fermentation based industry in India.

Text/Reference Books:

1. *Bioprocess Engineering*, Second Edition, Shuler ML; Kargi F, 2002, Prentice Hall PTR, New Jersey
2. *Bioprocessing*, Ward, O.P. (1991), New York,
3. *Bioseparations*, Van Nostrand Reinhold. Belter, P.A., Cussler, E.L., Hu, W.S., (1988), New York, John Wiley and Sons.
4. *Process Engineering in Biotechnology*, A.T. Jackson
5. *Bioprocess Technology Fundamentals*, Baily and Ollis
6. *Biochemical Reactors*, B. Atkinsom
7. *Chemical Engineering Vol. 1-6* J.M. Coulson and J.F. Richardson Pergamon Press.
8. *Bioprocess Engineering: Systems, equipments and facilities* (1994) Eds. K.B. Lydersen, N.A.D'elia and K.L. Nelson, John Wiley&Sons, New York

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)

Bioreaction Engineering

BT –524

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Structured growth models; Compartmental models; Cyberneticmodels

Unit II

Immobilized biocatalysts: external mass transfer; Internal diffusion;Reaction within catalysts.

Unit III

Reactor design (batch, continuous, fed-batch, plug flow, packedbed, airlift, immobilized enzyme/cell etc.); Optimal bioreactoroperation using simple reaction kinetics.

Unit IV

Dynamic simulation of bioreactor processes (batch, fed-batch,continuous etc.); Reactors in series.

Unit V

Pathway analysis: Stoichiometric analysis; Thermodynamics-derivedconstraints; Flux balancing techniques; Metabolic control analysis.

Texts/References:

1. J. Nielsen and J. Villadsen and G. Liden, Bioreaction EngineeringPrinciples, 2nd Edition, Kluwer Academic. 2003.

2. Irving J. Dunn, ElmarHeinzle, John Ingham, Jiri E. Prenosil,Biological Reaction Engineering: Dynamic ModellingFundamentals with Simulation Examples, 2nd Edition, Wiley-VCH. 2003.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)

Reproductive Genetics

BT –526

L	T	
4	**0**	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

UNIT-I

The similarities and differences between the processes of mitosis and meiosis and between the results of asexual and sexual reproduction; The relationship between an organisms' DNA, genes, and chromosomes, and the traits that result from this information; How genetic information is passed from parents to offspring and how it results in various traits?

Germ cells and sex: Genotypic & phenotypic sex determination in mammals, *D. melanogaster* and *C. elegans*; structure and formation of germ cell; fertilization; Imprinting and primordial germ cells, sex reversal.

UNIT-II

Animal models in human genetics research.

Molecular biology, cytology and biochemistry of ovogenesis: Synthesis and storage of maternal transcripts, proteins and cell organelles. rDNA amplification in amphibia; transcription on lampbrush chromosomes, ovulation and hormonal control in mammals.

Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity.

UNIT-III

Structure, chemistry, dynamics and regulation of sperm locomotion, capacitation and egg-surface targeting.

Egg activation, early cleavages and blastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

Implantation and formation of the placenta in mammals

UNIT-IV

Gastrulation in mammals-formation of primitive streak, morphogenetic movements and neural induction.

Organogenesis and fetal development

Pattern forming genes and expression in Drosophila and mammalian embryos

Recapitulation of Mendelian principles

UNIT-V

Animal Reproduction and Embryology: Reproductive Strategies (parthenogenesis, asexual reproduction, sexual reproduction, oviviporous, viviparous, ovoviviparous); Male and Female Reproductive Anatomy and Physiology; Pregnancy; Comparitive embryology- starfish, frog, chick, mammal; Fertilization, cleavage, gastrulation, germ layers and their derivatives; Induction, determination, and differentiation; reproductive cloning and its ethical issues.

Plant Reproduction: Alternation of generations in moss, fern, pine, and flowering plants; Spore and gamete formation; Fertilization and sporophyte formation; Seed structure and germination; Growth and development: hormonal control.

Text/Reference Books

1 Besser&Thorner, Comprehensive clinical endocrinology, 3rdEdition, Mosby 2002.
2 Emery and Rimons, Principles & Practice of Medical Genetics, Vol I-III, Churchill Livingstone, 2002.
3 Chaudhuri, Concise Medical Physiology, New Central Book Agency, 2002.
4 Gardner, In vitro fertilization: A practical approach, Informa healthcare, 2007.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)

Clinical Genetics & Counseling

BT –528

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit - I

- **The history and impact of genetics in medicine:** early beginnings, Gregor Mendel and the law of inheritance, chromosomal basis of inheritance, the fruit fly, the origin of medical genetics, classification of genetic disease, the impact of genetic disease, major new developments.

- **Patterns of inheritance:** Family studies, Mendelian inheritance, Non-Mendelian inheritance.

- **Risk Calculation:** Probability theory, Autosomal dominant inheritance, Autosomal recessive inheritance, sex linked recessive inheritance, the use of linked markers, Bayes' theorem and prenatal screening, Empiric risks.

Unit – II

- **Biochemical Genetics:** The inborn errors of metabolism, Disorders o amino acid metabolism, Disorders of steroid metabolism, Disorders of lipid metabolism, Lysosomal storage disorders, Disorders of purine/pyrimidine metabolism, Disorders of porphyrin metabolism, organic acid disorders, disorders of copper metabolism, peroximal disorders.

- **Pharmacogenetics:** Definition, Drug metabolism, Genetic variations revealed solely by the effects of drugs, hereditary disorders with altered drug response, Evolutionary origin of variations in drug responses, Pharmcogenomics.

Unit – III

- **The Genetics of Cancer:** Differentiating between genetic and environmental factors in cancer, oncogenes, tumor suppressor genes, genetics of common cancers, genetic counseling in familial cancer.

- **Genetics and congenital abnormalities:** Incidence, Definitions and classification of birth defects, genetic causes of malformations, environmental agents (teratogens), malformations of unknown cause.

Unit – IV

- **Genetic factors in common diseases:** Genetic susceptibility to common diseases, Diabetes mellitus, Hypertension, Coronary artery disease, schizophrenia, Affective disorders, Alzheimer's disease.

- **Carrier detection and presymptomatic diagnosis:** carrier testing for autosomal recessive and X-linked disorders, presymptomatic diagnosis of autosomal dominant disorders, ethical considerations in carrier detection and predictive testing.

Unit – V

- **Prenatal diagnosis of genetic disease:** Techniques used in prenatal diagnosis, New prenatal diagnosis techniques under development, Indications of prenatal diagnosis, special problems in prenatal diagnosis, termination of pregnancy, prenatal treatment.

- **Genetic counseling:** Definition, establishing the diagnosis, calculating and presenting the risk, discussing the options, communication and support, genetic counseling-directive or non directive? Outcomes in genetic counseling, special problems in genetic counseling.

Text/Reference Books:

1. Baker et al, A Guide to Genetic Counseling, Wiley-Liss, 1998.
2. Pastemak, An Introduction to Molecular Human Genetics:Mechanisms of Inherited Diseases, 2nd Edition, Fritzgarald, WileyLiss, 2005.
3. Iankowski and Polak, Clinical Gene Analysis and Manipulation:Tools, Techniques and Troubleshooting, CambridgeUniversityPress, 1996.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Plant Metabolite Engineering
BT –530

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Metabolism and Metabolic Engineering

Carbon Assimilation; Light absorption and energy conversion; Calvin Cycle; Hatch-slack pathway; Reductive pentose phosphate pathway; Carbon dioxide uptake and assimilation; Photorespiration; Glycolate metabolism.

Biological Oxidation and Release of Energy

Enzyme Kinetics and Analysis of Sequences of Reactions; Glycolytic pathway; Kreb's Cycle; High energy compounds; Oxidative phosphorylation; Chemiosmotic hypothesis; Pentose phosphate shunt pathway.

Unit II

Metabolism of Macromolecules

Biosynthesis and inter-conversion of carbohydrates; Biosynthesis, inter-conversion and degradation of lipids; Regulation of Metabolic Networks; Metabolic Flux Analysis; Metabolic Control analysis

Long-distance Transport Mechanisms

Turgor and stomatal movements; solute movement; source-sink relationship; water relations.

Unit III

Nitrogen, Sulphur and Phosphorus Metabolism

General aspects of nitrogen economy; Nitrate reduction; Pathways of ammonia assimilation; Reductive amination; Transamination; Regulation of nitrogen assimilation; Uptake, transport and assimilation of sulphate and phosphate.

Nitrogen Fixation

Symbiotic and non-symbiotic nitrogen fixation; Role of lectins; *nod*genes; *nif*genes; Structure, function and regulation of nitrogenase; Leghaemoglobin; Nodulins; Regulation and enhancement of nitrogen fixation.

Unit IV

Secondary Metabolism

Importance of Secondary Metabolites; Biosynthesis of phenolic compounds, isoprenoids, alkaloids and flavonoids; Metabolism of nucleotides, amino acids and vitamins; Bioproduction; biological treatment; and related natural and engineered systems.

Unit V

Bioinformatics for Metabolic Networks

Systems biology frameworks for metabolic engineering; Concepts of metabolic networks; Establishment of metabolic flux analysis and metabolic control analysis; Systems biology

framework for integration of mathematical modeling and global measurements at metabolite, protein and transcription levels.

Text/Reference Books:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press,2003
2. Chrispeels , MJ and Sadava, DE, Plants, Genes and Crop Biotechnology2003 2nd edition, American Society of Plant Biologists, Jones and Bartlett Publishers, USA
3. Arie Altman, Marcel Dekker, Inc. 2001 Agricultural Biotechnology
4. Biochemistry and Molecular Biology of Plants; Edited by Buchanan, Gruissem and Jones 2000, , American Society of Plant Biologists, USA
5. Edited by BR Jordan, 2nd Edition, The Molecular Biology and Biotechnology of Flowering, CABI, 2006.
6. Neil Wille, Phytoremediation: Methods and Reviews, 1st Edition, Humana Press, 2007.
7. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, CambridgeUniversity Press, 2007.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Renewable Energy Technology
BT –532

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I
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.

Unit II
Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

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

Unit IV
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.

Unit V
Production process of Bio diesel, introduction, process development, problems related to scale up process.

Text/Reference Books:
1) J.E. Smith – Biotechnology, 3rd ed. CambridgeUniv Press
2) S. Sarkar – Fuels and combustion, 2nd ed., University Press

Note for paper setter:
Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 2nd SEMESTER (Bio– Tech.)

Biotechnology Lab-III –512

L	T	P	
0	0	3	**Exam. : 50 Marks / 2 credits**
			Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I work to be carried out as per BT-502.

M. Tech. 2nd SEMESTER (Bio– Tech.)

Biotechnology Lab-IV –514

L	T	P	
0	0	3	**Exam. : 50 Marks / 2 credits**
			Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I work to be carried out as per BT-504.

M. Tech 3rd SEMESTER (Bio– Tech.)
ADVANCED PLANT BIOTECHNOLOGY
BT –601

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Plant Tissue Culture

Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.

Protoplast Culture and Somatic Hybridization

Protoplast isolation; Culture and usage; Somatic hybridization -methods and applications; Cybrids and somatic cell genetics.

Unit II

Agrobiology

Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid.

Genetic Transformation

Agrobacterium-mediated gene delivery; Cointegrate and binary vectors and their utility; Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; Screenable and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting.

Unit III

Molecular Mapping & Marker Assisted Selection (MAS)

Quantitative and qualitative traits; MAS for genes of agronomic importance, e.g. insect resistance, grain quality and grain yield; Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers; Construction of genetic and physical map; Gene mapping and cloning; QTL mapping and cloning.

Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance

Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.

Unit IV

Genetic Engineering for Plant Architecture and Metabolism

Seed storage proteins; Protein engineering; Vitamins and other value addition compounds; Source-sink relationships for yield increase; Post-harvest bioengineering; Plant architecture; Flowering behaviour

Plants as Biofactories

Concept of biofactories; Fermentation and production of industrial enzymes, vitamins and antibiotics and other biomolecules; Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation

Unit V

Plant Genomics

dentification of candidate genes using genetic information (positional cloning), using biochemical and expression analysis (microarray analysis, proteomics, metabolomics); Characterization and functional analysis of candidate genes: transformation, mutant populations, knockout systems; Heterologous expression systems; Protein analysis; Bioinformatics and databases; Genoinformatics.

Eco-biotechnology

Biosensors; Biofuels; Marine biofarming; Plant genetic resources; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Biosafety and containment practices

Texts/References:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press,2003
2. Chrispeels , MJ and Sadava, DE, Plants, Genes and Crop Biotechnology2003 2nd edition, American Society of Plant Biologists, Jones and Bartlett Publishers, USA
3. Arie Altman, Marcel Dekker, Inc. 2001 Agricultural Biotechnology
4. Biochemistry and Molecular Biology of Plants; Edited by Buchanan, Gruissem and Jones 2000, , American Society of Plant Biologists, USA
5. Edited by BR Jordan, 2nd Edition, The Molecular Biology and Biotechnology of Flowering, CABI, 2006.
6. Neil Wille, Phytoremediation: Methods and Reviews, 1st Edition, Humana Press, 2007.
7. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, CambridgeUniversity Press, 2007.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)
ADVANCED BIOCHEMICAL ENGINEERING
BT –603

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Biochemical Engineering: Overview of biotechnology, Enzyme Catalysis and immobilized biocatalysts (principles of enzyme catalysis; kinetics of single substratereactions: enzyme inhibition, denaturation and inactivation; methods of immobilizations; Electrostatic, external and internal mass transfer effects or immobilized kinetics.

Unit II

Microbial growth (stoichiometry and energetics; unstructured and structured models. transport and Reactor Process (continuous stirred tank, plugflow and packed bed bioreactors; gasliquid mass transfer; mass balance for two phase reactors; power requirements; sterilization).Kinetics of cell growth; Mathematical models for substrate uptake and product formation; Plasmid stability in recombinant cell cultures; Media and air sterilization.

Commercial strain development: Induced mutation, over producing decontrolled mutants, genetically engineered strain.

Unit III

Downstream processing -Product recovery and purification (Centrifugation; ultrafiltration; precipation; chromotography; electrophoresis and crystallization; solvent mediated separation.

Unit IV

General Bioprocess plant design information;Piping and instrumentation; Materials of construction for bioprocess plants;Mechanical design of process equipment; Vessels for biotechnology application; Novel bioreactor designs; Developments in aeration & agitation in bioractors; RTD and mixing in bioreactors; Rector dynamics Scale-up and scale down of bioreactors.

Unit V

Design of fermenters; Design considerations for maintaining sterility of process streams processing equipment; Selection and specification of equipment for handling fluids and solids; Selection, specification design of heat and mass transfer equipment used in bioprocess industries; Design of facilities for cleaning of process equipment used in biochemical industries; Utilities for biotechnology production plants; Processeconomics; Bioprocess validation; Safety considerations; Case studies.

Texts/References:

1. Industrial Microbiology, Prescot and Dunn,
2. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press,Macmillan Publ. Ltd.
3. Biochemical Engineering Fundamentals, Bailey &Olis. MGH.
4. Comprehensive Biotechnology By Moo-Young Vol1-4
5. Biotechnology by Rehm and Reed Vol 1-12
6. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
7. Treybal, R.E., Mass-Transfer Operations, MGH
8. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
9. Process system analysis & Control – D. R. Coughanowr MGH.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)

Biotech Resource Planning & IPR

BT –615

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

An overview of commercial products/ services through process biotechnology; Issues pertaining to development of biotechnology; General aspects related to the quality control of bioprocesses.

Unit II

Quality criterion for representative bioprocesses: Bioinoculants, Antimicrobial agents, metabolites, enzymes, therapeutic proteins; Health hazards in biotechnology and containment. Biosafety considerations and containments.

Unit III

Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies

Unit IV

Agreements and Treaties

History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

Bioinformatics and databases in biotechnology; Academia-industry interaction and technology transfer; Social and ethical issues related to biotechnology.

Unit V

Patent filing procedures

National & PCT filing procedure; Time frame and cost; Status ofthe patent applications filed; Precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting -introduction to existing schemesPatent licensing and agreementPatent infringement- meaning, scope, litigation, case studies

Text/ Reference Books

BAREACT, Indian Patent Act 1970 Acts & Rules, Universal LawPublishing Co. Pvt. Ltd., 2007

2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition,Manupatra Information Solution Pvt. Ltd., 2007

Important Links:

http://www.w3.org/IPR/

http://www.wipo.int/portal/index.html.en

http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/ - 31k - Cached - Similar page
http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)
Biopharmaceutical Technology
BT –617

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I

Drug Development in Pharmaceutical Process

- Production of pharmaceuticals by genetically engineered cells (hormones, interferrons)
- Microbial transformation for production of important pharmaceuticals (alkaloids, steroids and semi-synthetic antibiotics)
- Techniques for development of new generation antibiotics
- Protein engineering, drug design, drug targeting

Unit II:

Disease Diagnosis and Therapy

- ELISA and hybridoma technology
- DNA vaccine
- Gene Therapy
- Toxicogenomics

Unit III:

Proteomics in Drug Development

- Role of Proteomics in Drug Development
- Diagnosis of disease by Proteomics
- Separation and identification techniques for protein analysis
- Development of antibody based protein assay for diagnosis

Unit IV:

Diagnosis and Kit Development

- Use of enzymes in clinical diagnosis
- Use of biosensors for rapid clinical analysis
- Diagnostic kit development for microanalysis

Unit V

Nutraceutical: Water soluble and fat soluble vitamins, their functions; GMP, GLP and clean room concept, Role of US-FDA in biotech based industry.

Texts/References:

1. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University Press, 1996
2. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)
Process Control and Instrumentation
BT –619

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit I
Complex analysis - Definition and properties of analytic functions; Cauchy-Riemann equations, harmonic functions; Power series and their properties; Elementary functions; Cauchy's theorem and its applications; Taylor series and Laurent expansions; Residues and the Cauchy residue formula; Evaluation of improper integrals; Conformal mappings; Inversion of Laplace transforms.

Unit II
First Principles model development; Process dynamics for first, second and higher order systems: linearization, transfer function models, effect of poles, zeros and time delays on system response

Unit III
Instrumentation: control of pH, dissolved oxygen, temperature, redox potential etc.; Introduction to feedback control: objectives, PID control

Unit IV
Analysis of closed loop systems: stability, root locus, frequency response using Bode and Nyquist plots

Unit V
Control design techniques: design criteria, time and frequency domain techniques; Model based design; Tuning

Texts/References
1. D. E. Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, 2nd Edition, John Wiley & Sons, 2004.
2. B. W. Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall, New Delhi, 2003.
3. W. L. Luyben. Process Modelling Simulation and Control for Chemical Engineers, 2nd Edition, McGraw Hill, 1990.
4. G. Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice Hall, New Delhi, 2001.
Note for paper setter:
Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)
Process Modelling and Simulation
BT –621

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

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

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

Unit III:
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.

Unit IV:
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.

Unit V
Case study of a industry producing biotechnological products.

Texts/References:
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.
3)J.E. Bailey and D.F. Ollis, Biochemical Engg Fundamentals, 1986, McGraw Hill Book Company

Note for paper setter:
Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)

STEM CELLS IN HEALTH CARE

BT –623

L	T	
4	**0**	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit-I

- **Introduction**: Stem Cell Biology, Fate Mapping of Stem Cells.
- **Cell Cycle Control,** Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells.
- **The Drosophila Ovary**: An In Vivo Stem Cell System

Unit-II

- **Male Germ-line Stem Cells.**
- **Stem Cell Pattern:** Differentiated Parental DNA Chain Causes Stem Cell Pattern of Celltype Switching in *Schizosaccharomycespombe*
- **On Equivalence Groups** and the Notch/LIN-12 Communication System,

Unit-III

- **Epidermal Stem Cells:** Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon
- **Mesenchymal Stem Cells** of Human Adult Bone Marrow.
- **Stem Cells and Neurogenesis**

Unit-IV

- **Hematopoietic Stem Cells**: Repopulating Patterns of Primitive Hematopoietic Stem Cells, Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells: Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast
- **Stem cells in gene therapy:** Principles and Promise.

Unit-V

- **Primordial Germ Cells** as Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells.

- **Stem cell biosafety.**

- **Ethical issues in stem cell research and use**.

Texts/References:

1. Ann A. Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.

2. Peter J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
3. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, Academic Press, 2006.
4. A.D.Ho., R.Hoffiman, Stem Cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. C.S.Potten, Stem Cells, Elsevier, 2006.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)

Nanobiotechnology

BT –625

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit -I

Introduction to Nanoscience and Nanotechnology. Techniques used in Nanobiotechnology : Optical Microscopy, Atomic Force Microscopy, SEM etc

Unit –II

Production of nanoparticles: Collision / Coalescence mechanism of primary particle formation, nanoparticles agglomerates & aerogels Biological production of nanoparticles: fungi, bacteria, yeast and actinomycetes

Unit-III

Nano Structures: Introduction; Buckminsterfullerenes, Carbon nanotubes ,Quantum nanodots,Dendrimers,Superparamagneticnanoparticles,Nanorods,Nanoshells.
Nanostructures; Properties& Applications (mechanical, optical and electrical).

DNA based nanomechanical devices. Biosensor and Biochips.

Unit –IV

Biological Nanodevices**,**Nanosensors: Temperature Sensors, Smoke Sensors, Sensors for aerospace and defense:Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry Biosensors.

Unit- V

Use of nanoparticles as molecular imaging probes Use of optical microscopy to study the dynamic events in cells.
Nanobiotechnology for human health and food applications : nanoparticles for drug delivery, gene delivery,understanding the mechanism of macromolecular interactions etc Use of nanoparticles as sensors.
Nanoparticles for cleaning environment particularly heavy metal bioremediation.

Texts/References:

1 Sensors: Micro &Nanosensors, Sensor Market trends (Part 1&2) by H. Meixner.
2 Nanoscience& Technology: Novel structure and phenomea by Ping Sheng (Editor)
3 Physical properties of Carbon Nanotube-R Satio.
4. Applied Physics Of Carbon Nanotubes : Fundamentals Of Theory, Optics And Transport Devices - S. Subramony& S.V. Rotkins.

5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. CARBON NANOTECHNOLOGY- Liming Dai.
7. Nanotubes and Nanowires- CNR Rao and A Govindaraj RCS Publishing
8. Nanostructures and Nanomaterials - Synthesis, Properties and Applications - Cao, Guozhong
9.Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 3rd SEMESTER (Bio– Tech.)

Biomaterials

BT –627

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Unit 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.

Unit II:

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

Unit III:

Biopolymers: Synthesis from a simple biological monomer (eghyaluronate polymers); Dextrans (used in chromatography columns); Rubberllike materials produced by bacteria and fungi (Polyhydroxybutyrate PHB), Polycaprolactone(PCL).

Unit 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.

Unit V

Production of a copolymer of PHB and PHV(polyhydrovaleric acid), sold as Biopol by fermentation on *Alcaligeneseutrophus*; Biodegradable polymers.

Texts/References:

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

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

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech 2nd SEMESTER (Bio– Tech.)
Clinical Trials & Bioethics
BT –629

L	T	
4	0	**Theory : 100 Marks / 4 credits**
		Sessional : 50 Marks / 2 credits
		Total : 150 Marks / 6 credits
		Time : 3 Hrs.

Clinical Trials & Bioethics

UNIT - I

Clinical Research: Definition and basic concept; Pre clinical, toxicity studies, evolution of drugs and Indian regulatory framework; Guidelines for undertaking clinical trails. Structure, content & format for clinical study report; Approval for clinical trials; Responsibility of sponsor, investigator & ethical committee.

Testing of Drugs on Human Volunteers: Introduction; origin of clinical trials, informed consent, benefits and risks of participating in a clinical trial, side effects, and contents of informed consent.

UNIT - II

Clinical Trials: types, phases of clinical trials, ethical issues in research involving human participants.

Eugenics; Genetic diseases: screening and treatment; Genetic therapy; reproductive technologies (Artificial Insemination, In-vitro Fertilization, Gamete Intrafallopian Transfer & Zygote Intrafallopian Transfer).

UNIT - III

Biomedical basis of Diseases. General Pharmacology, organization and functions of various systems including drug used in the management of various diseases. Drug discovery and Development. Clinical Data Management.

Ethical issues in Human Immuno-deficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) and issues regarding day-to-day health care and organ transplant

UNIT - IV

Animal toxicology (Non-clinical toxicity study), Animal pharmacology, Human Pharmacology (Phase I), Therapeutic exploratory trail (Phase II), Therapeutic confirmatory trails (Phase II), Post marketing trails (Phase IV), Studies in special population.

Responsibility for safety: Safety and risk - assessment of safety and risk - risk benefit analysis-reducing risk.

UNIT – V

Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.

Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology-interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics.

Texts/References:
Texts/References:

1. Wilson, Clinical Genetics, Wiley-Liss, 2000.
2. Robinson and Linden, Clinical Genetics Handbook, 2nd Edition Blackwell Science, 1994.
3. Rasko and Downes, Genes in Medicine, Chapman & Hall, 1996.
4. Young, Introduction to Risk Calculation in Genetic Counselling, 3rdEdition Oxford University Press, 2006.

Note for paper setter:

Eight questions will be set in the question paper. Candidates will be required to attempt five questions.

M. Tech. 3rd SEMESTER (Bio– Tech.)

Biotechnology Lab-V –607

L	T	P	Exam. : 50 Marks / 2 credits
0	0	3	Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I work to be carried out as per BT-601.

M. Tech. 3rd SEMESTER (Bio– Tech.)

Biotechnology Lab-VI –609

L	T	P	Exam. : 50 Marks / 2 credits
0	0	3	Sessional : 50 Marks / 2 credits
			Total : 100 Marks / 4 credits

Laboratory I work to be carried out as per BT-603.