PROGRAM SPECIFIC OUTCOMES (PSO): M.Tech(Biotechnology)

At the end of the programme, the student will

PSO1. Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences.

PSO2. Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

PSO3. Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology

PSO4. Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists.

PSO5. be able to handle research problems and write dissertations.

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
M.TECH 1st YEAR (BIOTECHNOLOGY)
SEMESTER 1
CBCS Scheme effective from 2016-17

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours /week
			L	T	P	Total Credits	Marks of Class work	Theory	Practical	Total		
1	16MBT21C1	Genetic Engineering	4	0	-	4	50	100	-	150	3	4
2	16MBT21C2	Industrial Biotechnology	4	0	-	4	50	100	-	150	3	4
3	16MBT21C3	Molecular and Evolutionary Biology	4	0	-	4	50	100	-	150	3	4
4	16MBT21C4	Advanced Environmental Biotechnology	4	0	-	4	50	100	-	150	3	4
5	16MBT21CL1	Lab Course -I (Based on 16MBT21C1)	-	-	2	2	50	-	50	100	3	4
6	16MBT21CL2	Lab Course -II (Based on 16MBT21C2)	-		2	2	50	-	50	100	3	4
7	16MBT21CL3	Lab Course -III (Based on 16MBT21C3)	-	-	2	2	50	-	50	100	3	4
8	16MBT21CL4	Lab Course -IV (Based on 16MBT21C4)	-	-	2	2	50	-	50	100	3	4
		TOTAL				**24**						

NOTE:

1. **Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.**

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
M.TECH 1st YEAR (BIOTECHNOLOGY) SEMESTER 2
CBCS Scheme effective from 2016-17

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours/ week
			L	T	P	Total Credits	Marks of Class works	Theory	Practical	Total		
1	16MBT22C1	Bioinformatics	4	0	-	4	50	100	-	150	**3**	**4**
2	16MBT22C2	Immunotechnology	4	0	-	4	50	100	-	150	**3**	**4**
3	16MBT22C3	High Resolution Techniques in Biotech	4	0	-	4	50	100	-	150	3	**4**
4	16MBT22C4	Bioprocess Engineering	4	0	-	4	50	100	-	150	3	**4**
5	16MBT22C5	Scientific Writing & Presentation Skills	-		-	2	50	-	-	50		**2**
6	16MBT22CL1	Lab Course I (Based on 16MBT22C1)	-	-	2	2	50	-	50	100	3	**4**
7	16MBT22CL2	Lab Course II (Based on 16MBT22C2)	-	-	2	2	50	-	50	100	3	**4**
8	16MBT22CL3	Lab Course III (Based on 16MBT22C4)	-	-	2	2	50	-	50	100	3	**4**
9	16MBT22D1 Or 16MBT22D2 Or 16MBT22D3	Elective-1	4	0	-	4	50	100	-	150	**3**	**4**
10		Open Elective				3						
11		Foundation Elective				2						
		TOTAL	**33**									

NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Elective 1 : Choose any one from the following three papers:

16MBT22D1 - Advanced Animal Biotechnology 16MBT22D2
- Plant Tissue Culture & Industrial Applications
16MBT22D3 - Protein Engineering

Open Elective: A candidate has to select this paper from the pool of Open Electives provided by the University.

Foundation Elective: A candidate has to select this paper from the pool of Foundation Electives provided by the University.

M. Tech 1st SEMESTER (Bio– Tech.)
Genetic Engineering
16MBT21C1

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

COURSE OUTCOMES:

CO1 On completion of the course the scholars will acquire knowledge on the concepts and terminology in genetic engineering.
CO2 Students will be familiar with various cloning strategies in prokaryotes as well as in eukaryotes.
CO3 Students will learn various techniques in genetic engineering.
CO4 They will also get awareness about the social and ethical issues concerning cloning by genetic engineering

Unit I

Molecular tools in Recombinant DNA technology- Restriction Enzymes and DNA Modifying Enzymes (Polymerase, Reverse Transcriptase, Ligase, Alkaline phosphatase, Terminal deoxynucleotide transferase, Nuclease- S1 nuclease, Polynucleotide kinase, Cohesive and blunt end ligation; Linkers; Adaptors); Nick translation, Random priming; Radioactive and Non-radioactive Probes; Hybridization techniques: Northern, Southern, Colony hybridization and Fluorescence in -situ Hybridization; Chromatin Immuno-precipitation; DNA-Protein Interactions-Electromobility Shift Assay; DNase I footprinting;

Unit II

Gene Cloning Vectors: Plasmid vectors- pUC18/19, Bluescript vectors- pBR322, Phagemid-M13 mp vectors, Insertion and Replacement vectors, Lambda vectors, EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); Shuttle vectors. PCR: Introduction, types and applications. Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, Automated DNA sequencing, RNA sequencing.

Unit III

Gene Cloning Strategies, Transformation and selection of recombinant, Construction of Genomic library and cDNA library, Alternative strategies of Gene Cloning, Cloning of differentially expression genes, Expression cloning; Jumping and hopping libraries; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Site directed mutagenesis, Transfection techniques.

Unit IV

Gene therapy: Introduction, types and their applications; Gene silencing: Principle and

application of gene silencing; Introduction to siRNA technology, Micro RNA, Construction of siRNA vectors, Gene knockouts and Gene Therapy, Creation of knockout mice, Disease model, Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array, Gene tagging (T-DNA tagging and Transposon tagging) in gene analysis (identification and isolation of gene).

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.

M. Tech 1st SEMESTER (Bio– Tech.)

Industrial Biotechnology

16MBT21C2

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

COURSE OUTCOMES:

CO1 On completion of the course the scholars will acquire knowledge on industrial biotechnology.

CO2 Students will be familiar with various strategies for accessing microbial secondary metbolites.

CO3 Students will learn various techniques of ethanol production from sugar and starch based feed stocks.

CO4 They will also get awareness about the production of food grade enzymes in wild and engineered strains

Unit I

Introduction, History and applications of Industrial Biotechnology. New approaches to microbial Isolation .Production Media: Characteristics of ideal production media. Raw material selection and medium development for industrial fermentations

Unit II

Screening: Cell based assay for anti infective compounds, Enzymes from extreme environment. Strategies for accessing microbial secondary metabolites from silent biosynthetic pathways.

Unit III

Ethanol Production from sugar and starch based feed stocks. Industrial production of gluconic, fumaric and lactic acid . Industrial production of cellulase , pectinase and β- galactosidase.

Unit IV

Production of food grade enzymes in wild and engineered strains. Application of enzymes and microbes for industrial production of vitamin K and Coenzyme Q.

Text/Reference Books:

-Comprehensive Biotechnology: Industrial Biotechnology and Commodity Products 2nd Editions Vol.3 Editor-in –Chief Murray Moo Young

-Manual of Industrial Microbiology and Biotechnology 3rd Edition . Editor in chief Richard H . Baltz, Julian E Davis, Arnold L. Demain . ASM Press Washington DC

-Industrial Microbiology: An Introduction. Michael J.Waites, Neil L Morgan, John S. Rockey, Gary Higton . Blackwell Publishing

-Process Biotechnology Fundamentals 3rd Edition S.N. Mukhopadhyay. Viva Books. -
Industrial Microbiology 2nd Edition Arvind H. Patel . Mac Millian Publishers India Ltds.
- Manual of Industrial Microbiology and Biotechnology 2nd Edition . Editor in chief Arnold L. Demain, Julian E Davis,. ASM Press Washington DC
-Advances in Biotechnology H.N.Thatoi and Bibhuti Bhusan Mishra Stadium Press LLC USA.

M.Tech. 1st SEMESTER (Bio-Tech.)
Molecular and Evolutionary Biology
16MBT21C3

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students would be able to understand the central dogma of life and different processes related to it.
CO2 Students would be able to isolate and identify the concerned purified molecule from raw material. Students would be able to amplify the purified material for further applications.
CO3 Students would be able to appreciate the difference and importance of optimum conditions of in vivo to create the same in vitro conditions to get perfect results versus the survival fight in changed environment, alterations, mutations and their role in diseases and evolution.
CO4 Students would be able to design their own experiments and do alternations as per requirements; a step from technical followers to scientific aptitude development

Unit I

Introduction to Molecular Biology

Molecular History: origin and evolution of molecular biology, DNA structure, biophysio-chemical properties, different types of DNA.Genome organization in prokaryotes and eukaryotes; DNA stability; DNA melting; DNA methylation and imprinting, significance of molecular biology.

Unit II

DNA Replication, Repair, Recombination and Mutations

Replication in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single Stand and circular DNA; Gene stability. DNA repair and enzymes; Photoreactivation, Nucleotide excise repair, Mismatch correction, SOS repair recombination; Homologous and non - homologous; Site specific recombination; Chi sequences in prokaryotes. Practical applications of DNA Replication, Repair, Recombination and Mutations.

Unit III

Application of Transcription, Translation and Gene Regulation

Practical applications of Transcription and Post Transcriptional Modifications.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 cheprones; Protein stability; Protein turnover and degradation. Practical applications of translation and gene regulation

Unit IV

Evolutionary Molecular Biology: Mutations and transposable elements, molecular markers, molecular clock and molecular dating; Haplo groups: mitochondrial and Y chromosome haplogroups, their origin, relation to human migration and diseases, molecular risk assessment based on haplo groups and molecular markers, importance and danger of molecular risk assessment, personalized medicine. Different projects related to ancestry, population genetics and prospects of personalized medicine.

Text/ Reference

1. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 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 Cummmings Publishing Company Inc. 2007.

3. Albert*set al*.; Molecular Biology of the Cell, 4th Ed. Garland, 2002.

4. Genographic project and related books.

M. Tech. 1st SEMESTER (Bio–Tech.)
Advanced Environmental Biotechnology
16MBT21C4

L T	Theory : 100 Marks
4 0	Sessional : 50 Marks
	Total : 150 Marks
	Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the basic concept environment, pollutant, and role of biotechnology in environmental pollution
CO2 Students will be able to understand the concepts of bioremediation, and different methods of sewage treatment.
CO3 Students will be able to understand the different issues associated with environmental pollution such as acid rain, global warming, carbon footprinting and methods for pollution control
CO4 Students will be able to understand the different laws associated with pollution control

UNIT I

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

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

UNIT II

Bioremediation : What is bioremediation? Types of bioremediation, Applications of bioremediation
Sewage and Waste water treatment Systems - Primary, Secondary and tertiary treatments. Biological processes for industrial effluent - aerobic biological treatment, anaerobic biological treatment, periodic
biological reactors.

UNIT III

Environmental Issues: Acid rain and its effects on ecosystem (flora, fauna and human beings), Climate change, global warming–causes and impact of global warming, International initiatives to control global warming ,carbon footprinting, Coral reef, Biosafety protocol (1999-2000), Environmental ethics: Issues and possible solutions

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

UNIT IV

Environmental Laws: Environmental policy resolution, legislation, public policy strategies in pollution control. Wild life protection act, 1972 amended 2002. Forest conservation act, 1980. Indian forest act 1927.

Air (prevention & control of pollution) Act 1981 as amended by amendment 1987 & rule1982. Motor vehicle act, 1988, The environment (protection) Act, 1986, rules 1986.

The water (prevention &control of pollution) Act, 1974 as amended by amendment 1978 & rules 1975.Environment protection issues & problems, international & national efforts for environment protection.

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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 14thEd. (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.
10. Environmental administration & law- Paras Diwaa.

M. Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – I
16MBT21CL1

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

Laboratory I work to be carried out as per 16MBT21C1

Course Outcomes:-
At the end of the course the students shall be able to

CO1 practice the earned theoretical knowledge in genetic engineering techniques
CO2 get acquainted with DNA/gene products know about cloning strategies and expression systems.
CO3 get familiarize with the sequential processes in genetic engineering.

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M. Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – II
16MBT21CL2

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

Laboratory II work to be carried out as per 16MBT21C2

Course Outcomes:-

CO1 Students would be able to explain the basic techniques of industrial biotechnology laboratory.
CO2 Students will learn techniques of sampling from extreme environments.
CO3 Students will learn new approaches for microbial isolation and screening for anti infective compounds.
CO4 Students will be able to carry out isolation of microbial enzymes from extreme environments, purification and characterization .
CO5 Students and learn various methods for preservation of industrial strains.

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M. Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – III
16MBT21CL3

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

Laboratory III work to be carried out as per 16MBT21C3

1. DNA isolation, separation and purification
2. RNA isolation, separation and purification
3. Protein purification
4. PCR
5. Northern blotting
6. Southern blotting
7. Western blotting
8. Dot blot
9. RAPD
10. DNA sequencing

Text/References:

Molecular Cloning: A Laboratory Manual by Sambrooke. *et. al.*

Course Outcomes:-

At the end of this course student shall be able to
CO1 – practically understand DNA isolation, separation and purification and RNA isolation, separation and purification .

CO2 – practically understand DNA sequencing and RAPD

CO3 – practically understand PCR and Northen, Southern and Western blotting.

M. Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – IV
16MBT21CL4

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

Laboratory IV work to be carried out as per 16MBT21C4

Course Outcomes:-

CO1 Students will be able to learn the environmental pollutants
CO2 Students will be able to analyze the microbial content of different sources of water and soil
CO3 Students will be able to learn the bioremediation using microbes
CO4 Students will be able to learn the treatment of waste water
CO5 Students will be able to learn the concept of green house effect.

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M. Tech. 2nd SEMESTER (Bio– Tech.)
Bioinformatics
16MBT22C1

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Course Outcomes

CO1 Students would be able to learn basics of Bioinformatics and its applications.
CO2 Students would be able to submit, retrieve and use Biological data for use in basics and applied Sciences, industry, human genealogy and healthcare.
CO3 Students would be able to differentiate and appreciate the importance, drawbacks and applications of dry lab Biology and its dependence on Molecular wet lab data.
CO4 Students would appreciate the positive impact and role of interdisciplinary studies like Bioinformatics and the evolutionary trends of speciation from prokaryotes/lower organisms to eukaryotes/higher organisms for the overall benefit and future of life.

Unit I

Sequence-alignment related problems

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

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

Units II

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).

Units III

Structure databases; Secondary structure prediction; RNA structure prediction; M fold; Protein structure prediction by comparative modelling approaches(homology modelling, threading); Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches, side-chain packing; Energy minimization; Molecular dynamics; Rosetta; Structure comparison(DALI, VAST etc.); CASP; Protein-ligand docking; Computer-aided drug design (pharmacophore identification); QSAR; Protein-Protein interactions.

Unit IV

System-wide analyses: Transcriptomics: Microarray technology, expression profiles, data analysis; SAGE

Proteomics: 2D gel electrophoresis; Mass Spectrometry; Protein arrays; Metabolomics: 13C NMR based metabolic 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, 1st Edition, Wiley-Liss, 2003.

4. P. E. Bourne and H. Weissig.Structural Bioinformatics.Wiley.2003.

5. C. Branden and J. Tooze, Introduction to Protein Structure, 2nd Edition, Garland Publishing, 1999.

M. Tech. 2nd SEMESTER (Bio– Tech.)
Immunotechnology
16MBT22C2

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

COURSE OUTCOMES:
After completing the course students will:
CO1 have a detailed understanding of Component of immunity
CO2 know antigen presentation on a detailed molecular level
CO3 understand the concept immunology and the immune system .
CO4 have a in depth knowledge of the cellular and molecular basis for autoimmune disease and allergies.
CO4 have basic knowledge of tumor immunology and the development of novel recombinant antibodies for treatment of cancer and autoimmune disease.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

UNIT I

Innate and acquired immunity; Cells and Organs of the Immune System; Primary and Secondary Lymphoid Organs; Humoral and Cell- mediated Immune Response; Antigens; Antigenic Determinants: Isotype, Allotype & Idiotype; Immunoglobulins: Structure and Function; Monoclonal Antibodies.

UNIT II

Organization and Expression of Immunoglobulin Genes; Generation of Antibody Diversity; Class Switching; Antibody Engineering; Antigen Processing & Presentation; T-Cell Receptor; T-cell Maturation, Activation & Differentiation; Positive & Negative Selection; Signaling Pathways.

UNIT III

Cytokines; Role of T- helper cells in Cytokine Production; Cell Mediated Effecter Responses; Major Histo-compatibility Complex, Peptide Binding by class I and class II molecules; Tissue and Organ Transplantation.

UNIT IV

Hypersensitivity; Autoimmunity; Vaccines; Complement System.
Immunodiagnostics: Introduction, antigen-antibody reactions, Immunoassay: ELISA, Radio immunoassay, Immunoprecipitin Reactions;
DNA based diagnostics: PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization,

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 .

5. Diagnostic Techniques in Genetics. J. L. Serre (Eds). John Wiley & Sons

M. Tech 2nd SEMESTER (Bio–Tech.)
High Resolution Techniques in Biotech.
16MBT22C3

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Course Outcomes

CO1 Students will be able to understand the advanced microscopic techniques such as phase contrast microscopy, fluorescence microscopy, atomic force and confocal microscopy.
CO2 Students will be able to understand the basic and advancement of spectroscopic techniques and their application in analysis of bio molecules.
CO3 Students will be able to understand the electrophoretic and chromatographic techniques for separation of biomolecules.

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 precipitation by organic solvents, Ion exchange, gel filtration, reversed phase, affinity chromatography, ultra centrifugation.

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, immune precipitation), and specialized applications (in vitro synthesis of protein, labeling, micro sequence analysis,

Text/Reference Books:

1.Biological Spectroscopy:Campbell and Durek.
2.Physical Biochemistry,2ndedition 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 aton 25
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.
6. Physical Biochemistry, 2ndedition by K.E.Vanholde (1985), Prentice Hall Inc.,New Jerse

M. Tech 2nd SEMESTER (Bio–Tech.) BIOPROCESS ENGINEERING 16MBT22C4

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Course Outcomes

CO1 Students would be able to explain the basic of bioprocess engineering and applications for downstream processing of intra cellular, products ranging from food, beverage to pharma industry.

CO2 Students get familiarity with various mechanisms like mass, heat transfer, mass and energy balances associated with bioprocess.

CO3 Students would be able to appreciate the sterilization of process fluids such as media and air.

CO4 Students having familiarization kinetics of batch , continuous operation of bioreactors for biomass formation , product , substrate and enzymatic reaction

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Unit-I

Introduction to bioprocess engineering: Overview of a bioprocess including upstream and downstream processing. Applications of Bioprocess Engineering in biotechnology. Concept of unit operation unit processes. Basics of materials and energy balances in a macroscopic view point

Unit-II

Fluid Mechanics: fluid verses solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient

Design of culture media for industrial fermentations

Sterilization of process fluids: Thermal death kinetic of microorganisms, Batch and Continuous Sterilization .Integration of reaction and separation

Unit-III

Heat and Mass Transfer in Bioprocessing operations: Mechanisms and equipment for heat transfer. Theories of Diffusional mass transfer. Oxygen transfer methodology in fermenter.

Fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations.

Unit-IV

Product recovery operations: Unit processes for recovery of intracellular fermentation products,

Combined operations: Immobilization, whole broth processing, Mass recycle.

Product recovery trains: Commercial enzymes, intracellular foreign protein from recombinant *E.coli,* polysaccharide and biogum recovery, antibiotics , ethanol , organic acid ,single cell protein.

List of References Books:

1. Biochemical Engineering fundamentals, Bailey and Ollis, Mcgraw Hill Pub.

2. Priciples of fermentation technology, PF stanbury and A Whitaker, Pergamon press

3. Unit Operation of Chemical Engineering, McCabe, Smith and Hariot, Mc Graw Hill Pub.

4. Coulson & Richardson's Chemical Engineering- Volume 1-6 (Chemical and Biochemical Reactors and process controls) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998

5. Bioprocess Engineering Basic concepts M.A Shuler, Fikiret Kargi, PHI, India

M. Tech 2ndSEMESTER (Bio–Tech.) Advanced Animal Biotechnology 16MBT22D1

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Course Outcomes

CO1 Students will be able to understand basic principles of animal cell culture and large scale culture of animal cells.

CO2 Students will be able to understand the gene transfer method for production of transgenic animals by transfection methods.

CO3 Students will be able to understand the ethical issues associated with animal cell culture.

CO4 Students will be able to understand the principles of tissue and organ transplant, development of vaccines, enzymes as therapeutic agents.

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 anial cell lines. Cryopreservation, Cell culture products, Hybridoma technology,

UNIT III

Gene transfer (transfection) methods, Embryonic stem cell transfer, In Vitrofertilization and embryo transfer. Gene therapy, Animal cloning & ethical issues.Genetic diagnostic methods and microarray technology

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

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, 2ndEdition. 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.31
5. Animal Biotechnology:Murray Moo-Young (1989), Pergamon Press, Oxford

M. Tech 2nd SEMESTER (Bio– Tech.)
Plant Tissue Culture and Industrial Applications
16MBT22D2

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Course Outcomes

CO1 Students will be able to understand the basics of plant tissue culture as micropropagation, production of virus free plants
CO2 Students will be able to understand the basics concepts of somaclonal and gametoclonal variations, different types of growth regulators
CO3 Students will be able to understand the problems in plant tissue culture and culture of endangered species
CO4 Students will be able to understand the production of secondary metabolites through bioreactor, and applications of plant tissue culture.

UNIT-I

Micropropagation (via organogenesis and embryogenesis) of floricultural, agricultural and pharmaceutical crops: Orchids, Chrysanthemum, Gerbera, Carnation, Anthurium, Bamboos, Spilanthes, Stevia, Psoralea, Chickpea and elite tree species of national importance. Production of virus free plants through meristem culture in orchids and fruit trees. Germplasm conservation in vitro.

UNIT-II

Variations: Somaclonal and gametoclonal variations, spontaneous, genetic and epigenetic variations. Culture systems: Differentiated, undifferentiated, physiological, biochemical and molecular role of minerals and growth regulators in understanding differentiation of organs under in vitro conditions.

UNIT-III

Problems in Plant Tissue Culture: contamination, phenolics, recalcitrance. Problems in establishment of regenerated plants in nature: hardening, association of mycorrhiza and rhizobia. Factors responsible for in vitro and ex vitro hardening.

UNIT-IV

Use of bioreactors in secondary metabolite production and scale up automation of plant tissue culture. Recent applications of tissue culture techniques and biotechnology in the introduction of economically important traits in horticultural, agricultural and medicinal plants.

Text / Reference Books:

1. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc. (2001).

3. Plants, Genes and Crop Biotechnology (2003) 2nd Edition by Chrispeels, M.J. & Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA.

4. Biochemistry and Molecular Biology of Plants: Edited by Buchanan B.B., Gruissem W, and Jones RL (2000), American Society of Plant Biologists, USA.

5. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews.

M. Tech 2nd SEMESTER (Bio–Tech.)
Protein Engineering
16MBT22D3

L	T
4	0

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Credits : 4 Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

Course Outcomes

CO1 Students will be able to understand different characteristics of protein to be engineered

CO2 Students will be able to understand various forces stabilizing proteins such as Van der waals, electrostatic, hydrogen bonding and thermodynamics.

CO3 Students will be able to understand different methods of protein engineering and analysis of proteins by spectroscopic and other methods.

CO4 Students will be able to understand the computational approaches of protein engineering, three dimensional structure analysis of protein and protein design

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.

Texts/References:

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

M. Tech. 2nd SEMESTER (Bio–Tech.)
Biotechnology Lab – I
16MBT22CL1

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

Laboratory I work to be carried out as per 16MBT22C1

- Basics of sequence analysis Retrieving a sequence-nucleic acid/Protein
- Local and Global Alignment-concepts Pair wise sequence alignment, multiple sequence alignment
- Motif and pattern searching, Regulatory sequence identification using Meme
- Gene finding: composition based finding, sequence motif-based finding.
- Phylogenetic prediction and analysis
- Representation of molecular structures and visualization
- Structure prediction
- Structure superposition tools, Energy minimization and simulated annealing
- Structure comparision
- Protein-Protein interactions
- Docking small molecules/peptides in active site of protein. Use of automated docking procedures. Free energy calculation.
- Findingtranscription regulatory signals
- System-wide analyses tools and techniques

Reference Books:

1. Bioinformatics: A practical guide by Baxeuarus and Ovelletie, John Wiley Publishers. 2.
. David W. Mount. Bioinformatics: Sequence and Genome Analysis 2nd Edition, CSHL Press, 2004.
3. 2. A. Baxevanis and F. B. F. Ouellette, Bioinformatics: a practical guide to the analysis of genes and proteins, 2nd Edition, John Wiley, 2001.
4. 3. Jonathan Pevsner, Bioinformatics and Functional Genomics, 1st Edition, Wiley-Liss, 2003.
5. 4. P. E. Bourne and H. Weissig. Structural Bioinformatics. Wiley. 2003.
6. 5. C. Branden and J. Tooze, Introduction to Protein Structure, 2nd Edition, Garland Publishing, 1999.

Course Outcomes:-

CO1 On completion of the course the scholars will acquire practical knowledge on the concepts and terminology in genetic engineering.
CO2 Students will be familiar with various cloning strategies in prokaryotes as well as in eukaryotes.
CO3 Students will practically learn various techniques in genetic engineering.
CO4 They will also get awareness about the social and ethical issues concerning cloning by genetic engineering

M. Tech. 2nd SEMESTER (Bio–Tech.)
Biotechnology Lab – II
16MBT22CL2

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

Laboratory II work to be carried out as per 16MBT22C2

LIST OF EXPERIMENTS:

1. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
2. Rocket electrophoresis
3. Antibody titre by ELISA method.
4. ELISA for detection of antigens and antibodies-DOT ELISA
5. Sandwich ELISA
6. Blood group mapping
7. Separation of leucocytes by dextran method
8. Separation of mononuclear cells by Ficoll-Hypaque
9. Preparation of antigens from pathogens and parasites
10. Slide and tube agglutination reaction
11. Complement fixation test.
12. Immunofluorescence technique
13. Lymphoproliferation by mitogen / antigen induced
14. SDS-PAGE, Immunoblotting, Dot blot assays

Course Outcomes:-

CO1 Students could independently perform diagnostics assays involving antigen-antibody reaction.
CO2 They also learn to perform the qualitative and quantitative analysis using antibody.
CO3 At the end of this course student shall be able to address all the practical aspects related to the subject of Immunotechnology covered in the theory paper.

M. Tech. 2nd SEMESTER (Bio–Tech.)
Biotechnology Lab – III
16MBT22CL3

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

Laboratory III work to be carried out as per 16MBT22C4

Course Outcomes:-

CO1 Students will be able to isolate the pure culture of microorganisms from the soil and assay the enzymatic activity of isolates.
CO2 Students would be able to optimize growth parameters and the production of enzyme in shake flask culture .
CO3 Student would be able to carry out extraction and primary isolation of enzyme using techniques of centrifugation and salting out .
CO4 Students would further purify the protein by dialysis and ion exchange chromatography techniques .
CO5 Student would carry out SDS-PAGE of protein fractions.

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
M.TECH 2nd YEAR (BIOTECHNOLOGY)
SEMESTER III
CBCS Scheme effective from 2017-18

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours /week
			L	T	P	Total Credits	Marks of Class works	Theory	Practical	Total		
1	17MBT23C1	Plant Biotechnology & Crop Improvement	4	0	-	4	50	100	-	150	3	4
2	17MBT23C2	Biochemical Engineering	4	0	-	4	50	100	-	150	3	4
3	17MBT23D1 or 17MBT23D2 or 17MBT23D3	Elective-I	4	0	-	4	50	100	-	150	3	4
4	17MBT23D4 or 17MBT23D5 or 17MBT23D6	Elective-II	4	0	-	4	50	100	-	150	3	4
5	17MBT23C3	Lab Course I (Based on 17MBT23C1)	-	-	2	2	50	-	50	100	3	4
6	17MBT23C4	Lab Course II (Based on 17MBT23C2)	-	-	2	2	50	-	50	100	3	4
7	17MBT23C5	Dissertation Phase I	-	-	4	4	100	-	-	100	-	8
8		Open Elective				3						
		TOTAL	**27**									

NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Elective-I: Choose any one from the following three papers:

17MBT23D1	Stem Cells in Health care
17MBT23D2	Bio-Nanotechnology
17MBT23D3	Clinical Genetics & Counselling

Elective-II: Choose any one from the following three papers:

17MBT23D4	Intellectual Property Rights
17MBT23D5	Advances in Applied Biotechnology
17MBT23D6	Bioethics & Biosafety

Open Elective: A candidate has to select this paper from the pool of Open Electives provided by the University.

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
M.TECH 2nd YEAR (BIOTECHNOLOGY)
SEMESTER IV
CBCS Scheme effective from 2017-18

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours /week
			L	T	P	Total Credits	Marks of Class works	Theory	Practical	Total		
1	17MBT24C1	Dissertation Phase II	0	0	14	14	100	-	400	500	-	28
		TOTAL	**14**									

M. Tech 3rd Semester (Bio–Tech.)
Plant Biotechnology & Crop Improvement
17MBT23C1

L	T	Theory : 100 Marks
4	0	Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes:

CO1 The students would be able to understand cutting edge technologies in plant genetic engineering
CO2 Importance of plant transformation for production of nutritionally better products.
CO3 Students would be able to understand role of marker assisted selection and breeding through techniques like RAPD, RFLP, AFLP, QTL mapping.
CO4 Molecular methods for breeding tissue culture for commercial applications.
CO5 The students will have knowledge of IPRs in agriculture, patents and socio-economic issues related to foods security.

UNIT I

Genetic engineering of plants: production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance; quality parameters: Modification of nitrogen fixing capabilities; Chloroplast engineering; gene pyramiding; RNAi technology.

UNIT II

Genetic Engineering for Plant Metabolism: Seed storage proteins; Protein engineering; Vitamins and other value addition compounds; Source-sink relationships for yield increase; Post-harvest bioengineering.
Molecular farming: Use of plants for production of neutraceuticals and other desired products.

UNIT III

Molecular breeding: 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. Role of molecular markers in crop improvement, conservation of biodiversity.

UNIT IV

Biosensors; Biofuels; Marine biofarming; Plant genetic resources; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Biosafety and containment practices. World Food Security: Causes of food insecurity, social economic issues, ensuring food security.

Text / Reference Books:

1. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc. (2001). 2. Plants, Genes and Crop Biotechnology (2003) 2nd Edition by Chrispeels, M.J. & Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA. 3. Biochemistry and Molecular Biology of Plants: Edited by Buchanan B.B., Gruissem W, and Jones RL (2000), American Society of Plant Biologists, USA. 4. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews.

M. Tech 3rd Semester (Bio–Tech.)
Biochemical Engineering
17MBT23C2

L	T	
4	0	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand basics of biochemical and chemical engineering
CO2 Students will be able to understand the kinetics of homogeneous and kinetics of growth, thermal death and enzyme catalyzed reactions
CO3 Students will be able to understand the basics of design of bioreactor, and sterilization of processing equipment
CO4 Students will be able to understand the bioseparation of proteins and enzymes.

UNIT I

Introduction to biochemical engineering: Chemical vs Biochemical Engineering, Recent developments in biochemical engineering.
Biochemical process calculations: Applications of laws of conservation of mass and energy to single and multistage process. Material and energy balances for unit operations and processes, integrated balances for manufacturing processes. Mass and energy balances in bioprocesses, flow sheet and process calculations, metabolic stoichiometry of growth and product formation

UNIT II

Biochemical reaction engineering: Review of kinetics for homogeneous reactions.
Kinetics of substrate utilization, product formation and biomass production: Monod growth model and its various modifications; structured and unstructured kinetic rate models; Thermal death kinetics of cells & spores; Plasmid stability in recombinant cell cultures;
Kinetics of enzyme-catalyzed reactions in immobilized states: Michaelis-Menten equation and its various modifications. Effects of External mass transfer in immobilized enzyme systems; analysis of intra particle diffusion and reaction.

UNIT III

Design equations for batch, continuous and semi batch reactors and their performance
Design of Reactors: Energy Balance and design of ideal, single phase flow reactors with heat effects
Bioprocess equipment design: General design information. Mass and energy balance, flow sheeting, piping and instrumentation.

Design considerations for maintaining sterility of process streams processing equipment Design of facilities for cleaning of process equipments used in biochemical industries; utilities for biotechnology production plants

UNIT IV

Biochemical separation engineering: Basic concepts of Bio-separation Technology; Separation characteristics of proteins and enzymes – size, stability, properties; purification methodologies

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

Text / Reference Books:

-Introduction to material and energy balances by Reklaitis G V, Wiley, New York
-Bioprocess Engineering Principles by P.M.Doran, Academic Press, Elsevier
-Stoichiometry, Bhatt V.I. and Vora S.M., Tata McGraw Hill
-Chemical Engineering Kinetics, Smith J.M., McGraw Hill
-Elements of Chemical Reaction Engineering, Scott Fogler H., Prentice Hall of India
-Biochemical Engineering Fundamentals by James E.Bailey & David F.Ollis, McGrew- Hill
-Process Equipment Design, Joshi, M.V.,Mahajani,V.V., Macmillan India Ltd.
-Parry's Chemical Engineer's Hand Book, Robert H.Parry, Don W.Green, McGraw Hill
-An introduction to biochemical Process Design in Chemical Engineering Problem in Biotechnology Shuler M L Vol I AICHE
- Bioseparations Engineering, M. R.Ladisch, Wiley Interscience
- Recovery processes for biological materials, Kennedy and Cabral,
- Bioprocess Engineering- Basic Concepts, Shuler M L, Kargi F, 2nd ed, Prentice Hall of India Ltd.

M. Tech 3rd Semester (Bio–Tech.)

Stem Cells in Health Care

17MBT23D1

L	T	
4	**0**	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks

Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the concept of totipotency and basic properties of stem cells

CO2 Students will be able to understand the properties of embryonic stem cells, adult stem cells, growth of stem cells in laboratory conditions.

CO3 Students will be able to understand the role of stem cells in drug discovery and therapeutic applications of stem cells in treatment of different diseases.

CO4 Students will be able to understand the genetically engineered stem cells.

UNIT I

Stem cell basics: Unique properties of stem cells – embryonic stem cells - adult stem cells – umbilical cord stem cells – similarities and differences between embryonic and adult stem cells. Properties of stem cells as pluripotency & totipotency

UNIT II

Embryonic stem cells: In vitro fertilization –culturing of embryos-isolation of human embryonic stem cells – blastocyst – inner cell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells.

UNIT III

Adult stem cells: Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.

Stem cell in drug discovery and tissue engineering: Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – stem cell based drug discovery, drug screening and toxicology.

UNIT IV

Genetic engineering and therapeutic application of stem cells: Gene therapy – genetically engineered stem cells – stem cells and Animal cloning – transgenic animals and stem cells – Therapeutic applications – Parkinson disease - Neurological disorder –heart disease - spinal cord injuries – diabetes –burns - HLA typing- Alzheimer's disease –tissue engineering application – production of complete organ - kidney – eyes - heart – brain.

Text / Reference Books:

1. Embryonic Stem cells by Kursad and Turksen. 2002.Humana Press.

2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem Cell Research. 2002. National Academic press

M. Tech 3rd Semester (Bio–Tech.)
Bio-Nanotechnology
17MBT23D2

L	T	
4	0	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the concept of bio-nanotechnology
CO2 Students will be able to understand the synthesis of nanoparticles, carbon nanotubes, graphene.
CO3 Students will be able to understand the properties and applications of nanomaterials.
CO4 Students will be able to understand different approaches for characterization of nanomaterials.
CO5 Students will be able to understand the scope of nanomaterials such as nanomedicine, DNA computers, biosensors etc.

UNIT I

Bio-Nanotechnology- An Overview: What can engineers learn from biology? From biotechnology to Bio-nanotechnology, Bio-nanomachines in action. Molecular recognition.

UNIT II

Nanomaterials-Synthesis, Properties and Applications: Synthesis, Properties & characterization of Gold, Silver and Zinc oxide - nanoparticles,Synthesis of Carbon Nano-Tubes and Graphene: Different methods of synthesis of CNTs: laser ablation, carbon arc method, Chemical vapor deposition, Electrodeposition, Flame synthesis etc., fullerenes its synthesis and applications. Properties of Carbon Nanotubes: Physical, Thermal, Electrical, Optical, Mechanical, Vibrational properties etc. Synthesis strategies for graphene, Improved Hummer's method, Properties of graphene.

UNIT III

Molecular Nanotechnology- Scanning Probe Microscopy, Auger, SEM, TEM, XRD (Powder/Single crystal), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Optical Twezers, Nanomanipulation, UPS (UV Photo electron spectroscopy), Particle size analyzer, UV-VIS-IR Spectrophotometers, FTIR,X-ray Photon Spectroscopy, Electron Dispersion Spectroscopy etc.

UNIT IV

Bio-Nanotechnology Today and Future: Basic capabilities, Nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.Pharmacy & Drug Delivery Systems: Food Processing and Storage; Vector and pest detection and control.

Text / Reference Books:

1. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley- VCH Verlag, GmbH & Co. KGaA, 2003.
2. David S. Goodsell, Bionanotechnology: Lessons from Nature, 1st Edition, Wiley-Liss, 2004. Neelina H. Malsch, Biomedical Nanotechnology, 1st Edition, CRC Press, 2005
3. Sharon, M. & Sharon, M (2012) Bio-Nanotechnology- Concepts and Applications, CRC Press.
4. David E. Reisner (2008) Bionanotechnology- Global Prospects, CRC Press.
5. Avouris, P., Klitzing, K. Von, Sakaki H. & Wiesendanger, R. (2003). Nano Science and Technology Series. Springer.

M. Tech 3rd Semester (Bio–Tech.)
Clinical Genetics & Counseling
17MBT23D3

L	T	
4	0	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the role of genetic diseases, chromosomal basis of inheritance.

CO2 Students will be able to understand the various disorders of metabolism, drug metabolism and pharmacogenomics

CO3 Students will be able to understand the genetic cause in diseases, malformations and genetics of cancer.

CO4 Students will be able to understand the techniques used in diagnosis of genetic diseases, disorders, and various factors associated with genetic counseling

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 of 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.

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

UNIT IV

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.

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.

M. Tech 3rd Semester (Bio–Tech.)
Intellectual Property Rights
17MBT23D4

L	T	
4	0	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

COURSE OUTCOMES:

CO1 On the completion of the course student will be able to know about IPR and also the importance of protecting their innovation.
CO2 They will be familiar with international and national law practiced and also recent issues on it.
CO3 Students will be familiar with patent filing procedure

UNIT I

Introduction to Intellectual Property, Types of IP: Patents, Trademarks, Copyright , Industrial design, Traditional knowledge, Geographical indications

UNIT II

Agreements and Treaties: GATT & TRIPS Agreement; Madrid agreement; Hague agreement WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT III

Patent filing procedures: National & PCT filing procedures; Time framed cost; Status of the patent application filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting; Patent licensing and agreement, Patent infringement

UNIT IV

Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances, GMO.

Text/Reference Books:

1. P. Narayanan. Intellectual Property Laws. Eastern Law House
2. Meenu Pal. Intellectual Property Laws. Allahabad Law Agency.
3. Intellectual Property Law containing Acts and Rules. Universal Law Publication Company

M. Tech 3rd Semester (Bio–Tech.)

Advances in Applied Biotechnology
17MBT23D5

L	T	Theory : 100 Marks
4	0	Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the role of biotechnology in agriculture for crop improvement, genetic engineering and molecular pharming.
CO2 Students will be able to understand the industrially important microbes for production of valuable products and bioremediation.
CO3 Students will be able to understand the advancement in genomics and biotechnology such as Artificial DNA synthesis, next generation sequencing, gene editing and production of transgenic animals etc.
CO4 Students will be able to understand the advancement in protein analysis such as protein folding, protein sequencing, and proteomics in drug development etc.

UNIT I

Biotechnology in agriculture: Use of agricultural waste for human benefit, control of pest by genetic engineering and ecological impact, crop development by genetic engineering case study of golden rice, molecular pharming, Ti plasmid, nif genes,

UNIT II

Microbial biotechnology: Industrially important microbes (*Streptomyces griseous*, *E. coli*), biopharmaceutical productions, recombinant protein production using bacteria, xenobiotic degradation using bacteria, bioremediation

UNIT III

Development in genomics: Artificial DNA synthesis, DNA sequencing, next generation sequencing, transposons, RNA silencing, CRISPR/CAS targeted gene editing, metagenomics, chromosome remodelling, human genome project: application and outputs, stem cell cultures in the production of transgenic animals.

UNIT IV

Development in proteomics: folding of proteins, Ramachandran plot, peptide synthesis, peptide mapping, peptide sequencing - automated Edman method, high-throughput protein sequencing, protein targeting, polyclonal antibodies, proteomics in drug development, mass spectroscopy of proteins, protein array, tumor antigens

Text/Reference Books:

1. Liebler, “Introduction to Proteomics” Humana Press.
2. Pennington, S.R and M.J. Dunn, “Proteomics: Protein Sequence to Function”. Viva Books,
3. Karp, Gerald “Cell and Molecular Biology: Concepts and Experiments” 4th Edition, John Wiley.
4. Lewin’s GENES XI, Published by Jones & Bartlett Learning; 11 edition.
5. Principles of Genome Analysis and Genomics by S.B. Primrose and R.M. Twyman, Blackwell Publishing.

M. Tech 3rd Semester (Bio–Tech.)
Bioethics and Biosafety
17MBT23D6

L	T	Theory : 100 Marks
4	0	Sessional : 50 Marks
		Total : 150 Marks
		Credits : 4, Time: 3 Hrs.

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks

Course Outcomes

CO1 Students will be able to understand the general characteristics of biosafety, biohazard, and biosafety for human and environment
CO2 Students will be able to understand the risk associated with GMOs, bio-safety guidelines and different committees for biosafety in research and development
CO3 Students will be able to understand the social aspect and ethical issues associated with human cloning, gene therapy, genetic discrimination etc.
CO4 Students will be able to understand the Cartagena protocol on biosafety, Biosafety management and national regulations

UNIT I

Bio-safety – Definition, Requirement, Bio-safety containment facilities, Bio-safety against infectious agents/microorganism; bio-safety levels for infectious agents and infected food/animals; introduction of biological safety cabinets; biohazards, Biosafety for human health and environment; designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA

UNIT II

Bio-safety issues related with GMOs; the risk of introducing genetically engineered organism to environment- ecological safety; Indian government bio-safety guidelines; role of RCGM (Review Committee on Genetic Manipulation), Role of GEAC (Genetics Engineering Approval Committee), Role of IBSC (Institute Bio-safety Committee) in research and development of GMOs (transgenics), in Medicine, Food and Agriculture; Guidelines for environment release of GMOs; Risk assessment, Risk management.

UNIT III

Social issues: Genetic discrimination: insurance and employment, human cloning, foeticide, sex determination

Ethical issues: Somatic and germ line gene therapy, clinical trials, ethical committee function. Social and ethical issues

UNIT IV

Overview of National regulations and relevant International Agreements including Cartagena protocol on biosafety, Biosafety management

Text/Reference Books:

1. Biological Safety: Principles and Practices (Biological Safety : Principles & Practices) by Diane O., Ph.D. Fleming and Debra Long Hunt (Aug 30, 2006)
2. Biosafety in the Laboratory: Prudent Practices for handling and disposal of Infectious materials by National Research Council (U.S) (Dec 1989)
3. Genetically modified organism : A guide to Biosafety (Cabi) by George T Tzotzos (May, 1995)
4. Biological Safety Manual by Yale University.
5. Richard Sherlock & JD Morrey. Ethical Issues in Biotechnology, 2002

M. Tech 3rd Semester (Bio–Tech.)

Lab Course I

17MBT23C3

L	T	P
0	0	4

Exam : 50 Marks
Sessional : 50 Marks
Total : 100 Marks
Credits : 2

Lab Course I work to be carried out as per 17MBT23C1

Course Outcomes:-

CO1 The students would be able to practically understand cutting edge technologies in plant genetic engineering

CO2 Importance of plant transformation for production of nutritionally better products practically.

CO3 Students would be able to understand role of marker assisted selection and breeding through techniques like RAPD, RFLP, AFLP, QTL mapping.

CO4 Molecular methods for breeding tissue culture for commercial applications.

CO5 The students will have knowledge of IPRs in agriculture, patents and socio-economic issues related to foods security.

M. Tech 3rd Semester (Bio–Tech.)

Lab Course II

17MBT23C4

L	T	P	Exam : 50 Marks
0	0	4	Sessional : 50 Marks
			Total : 100 Marks
			Credits : 2

Lab Course II work to be carried out as per 17MBT23C2

Course Outcomes:-

CO1 Students will be able to learn law of conservation of mass in bioprocess and stoichiometry.
CO2 Students will be able to learn the monad growth model
CO3 Students will be able to learn the thermal death kinetics of cells
CO4 Students will be able to learn the kinetics of enzyme catalyzed reactions in immobilized state
CO5 Students will be able to learn the separation of biomolecules

M. Tech 3rd Semester (Bio–Tech.)
Dissertation Phase I
17MBT23C5

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

Sessional : 100 Marks
Total : 100 Marks
Credits : 4

COURSE OUTCOMES:

By the end of this course every student is expected to be able to

CO1 understand the process of research.
CO2 do literature survey to identify a research problem.
CO3 communicate and discuss research ideas.
CO4 plan and write dissertation synopsis.

M. Tech 4th Semester (Bio–Tech.)
Dissertation Phase II
17MBT24C1

L	T	P
0	0	14

Sessional : 100 Marks
Practical : 400 Marks
Total : 500 Marks
Credits : 14

COURSE OUTCOMES:

By the end of this course every student is expected to be able to

CO1 handle research problems and use modern research tools/methods.
CO2 analyse and review the existing literature on a research problem.
CO3 design and conduct experiments.
CO4 write dissertation and technical reports.
CO5 publish research papers.

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