

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	16MTB21C1	Genetic Engineering	4	0	-	4	50	100	-	150	3	4
2	16MTB21C2	Industrial Biotechnology	4	0	-	4	50	100	-	150	3	4
3	16MTB21C3	Molecular and Evolutionary Biology	4	0	-	4	50	100	-	150	3	4
4	16MTB21C4	Advanced Environmental Biotechnology	4	0	-	4	50	100	-	150	3	4
5	16MTB21CL1	Lab Course-I (Based on 16MTB21C1)	-	-	2	2	50	-	50	100	3	4
6	16MTB21CL2	Lab Course-II (Based on 16MTB21C2)	-	-	2	2	50	-	50	100	3	4
7	16MTB21CL3	Lab Course-III (Based on 16 MTB21C3)	-	-	2	2	50	-	50	100	3	4
8	16MTB21CL4	Lab Course-IV (Based on 16MTB21C4)	-	-	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	16MTB22C1	Bioinformatics	4	0	-	4	50	100	-	150	3	4
2	16MTB22C2	Immunotechnology	4	0	-	4	50	100	-	150	3	4
3	16MTB22C3	High Resolution Techniques in Biotech	4	0	-	4	50	100	-	150	3	4
4	16MTB22C4	Bioprocess Engineering	4	0	-	4	50	100	-	150	3	4
5	16MTB22C5	Scientific Writing & Presentation skills	-		-	2	50	-	-	50		2
6	16MTB22CL1	Lab Course I (Based on 16MTB22C1)	-	-	2	2	50	-	50	100	3	4
7	16MTB22CL2	Lab Course II (Based on 16MTB22C2)	-	-	2	2	50	-	50	100	3	4
8	16MTB22CL3	Lab Course III (Based on 16MTB22C4)	-	-	2	2	50	-	50	100	3	4
9	16MTB22D1 Or 16MTB22D2 Or 16MTB22D3	Elective-I	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.

Elective1: Choose any one from the following three papers:

16MTB22D1-Advanced Animal Biotechnology

16MTB22D2 –Plant Tissue Culture & Industrial Applications

16MTB22D3-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
16MTB21C1**

L T
4 0

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

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

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, Blue script 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 expressed 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. Russell; Molecular Cloning : A Laboratory Manual, 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 England Biolabs etc.

M. Tech 1st SEMESTER (Bio–Tech.)
Industrial Biotechnology
16MTB21C2

L T
4 0

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

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, 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/ReferenceBooks:

- Comprehensive Biotechnology: Industrial Biotechnology and Commodity Products^{2nd} Editions Vol.3
Editor-in –Chief Murray MooYoung
- Manual of Industrial Microbiology and Biotechnology 3rd Edition . Editorin chief Richard H . Baltz,
Julian E Davis, Arnold L. Demain . ASM Press Washington DC
- Industrial Microbiology: An Introduction. MichaelJ.Waites,NeilLMorgan,JohnS.Rockey,Gary Higton .
Blackwell Publishing
- Process Biotechnology Fundamentals3rdEdition S.N.Mukhopadhyay.Viva Books.
- Industrial Microbiology2ndEdition Arvind H.Patel.MacMillian Publishers IndiaLtds.
- 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
16MTB21C3

L T
4 0

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

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 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; Iso accepting tRNA, 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 Cummings Publishing Company Inc. 2007.
3. Alberts *et al.*; Molecular Biology of the Cell, 4th Ed. Garland, 2002.
4. Geno graphic project and related books.

M. Tech. 1st SEMESTER (Bio-Tech.)
Advanced Environmental Biotechnology
16MTB21C4

L T
4 0

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

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

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 : Vermi technology, waste water treatment using aquatic plants, root zone treatment. Aiming for biodegradable and eco friendly 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 & rule 1982. 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. Wastewater 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 Wastewater treatment and recovery. G. Mattock E. D. (1978) Ellis Horwood.
4. Biochemical Engineering Fundamentals 2nd ed. Bailey, J. E. and Ollis, D. F. (1986) McGraw 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) Elsevier Sciences.
7. Standard Method for Examination of water & wastewater 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); Kluwer Academic Press.
10. Environmental administration & law-Paras Diwaa.

M. Tech. 1st SEMESTER(Bio-Tech.)
Biotechnology Lab – I
16MTB21CL1

L T P
0 0 4

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

Laboratory I work to be carried out as per 16MTB21C1

M.Tech. 1st SEMESTER (Bio-Tech.)
Biotechnology Lab – II
16MTB21CL2

L T P
0 0 4

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

Laboratory II work to be carried out as per 16MTB21C2

M. Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – III
16MTB21CL3

L T P
0 0 4

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

Laboratory III work to be carried out as per 16MTB21C3

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.*

M.Tech. 1st SEMESTER (Bio–Tech.)
Biotechnology Lab – IV
16MTB21CL4

LTP
004

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

Laboratory IV work to be carried out as per 16MTB21C4

M.Tech. 2nd SEMESTER (Bio–Tech.)
Bioinformatics
16MTB22C1

L T
4 0

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

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

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: Micro array technology, expression profiles, data analysis; SAGE

Proteomics: 2D gel electrophoresis; Mass Spectrometry; Protein arrays; Metabolomics: ^{13}C NMR based metabolic flux analysis.

Texts/References:

1. David W. Mount. Bioinformatics: Sequence and Genome Analysis 2nd Edition, CSHL Press, 2004.
2. A. Baxevanis and F.B.F. Ouellette, Bioinformatics: a practical guide to the analysis of genes and proteins, 2nd Edition, John Wiley, 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
16MTB22C2

L T
4 0

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

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 & Idiotypic; 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 Effector 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.

Immunodiagnosics: Introduction, antigen-antibody reactions, Immunoassay: ELISA, Radio immunoassay, Immunoprecipitin Reactions;

DNABaseddiagnosics: 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), Ivon Roitt, Peter Delves, Blackswell, Scientific Publications. Oxford.
3. **Fundanental of immunology**. Paul W.E.(Eds) Ravenpress, New York.
4. **Immunology** by Prescott.
5. **Diagnostic Techniques in Genetics**. J.L. Serre (Eds). John Wiley & Sons

M. Tech 2nd SEMESTER (Bio-Tech.)
High Resolution Techniques in Biotech.
16MTB22C3

L T
4 0

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

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

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: Phasecontrast, 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, 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: Johnkenkel(1994),LewisPublishers. Bocaaton25
5. Principles and techniques of Practical Biochemistry: K.WilsonandJ.Walker(1994),Cambridge University Press,Cambridge.

6. Biophysical Chemistry: Principle and Techniques, 2nd edition 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

M. Tech 2nd SEMESTER (Bio-Tech.)
BIOPROCESS ENGINEERING
16MTB22C4

L T
4 0

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

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, McgrawHillPub.
2. Principles of fermentation technology, P. F. Stanbury and A. Whitaker, Pergamon press
3. Unit Operation of Chemical Engineering, McCabe, Smith and Hariot, McGrawHillPub.
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 2nd SEMESTER (Bio-Tech.)
Advanced Animal Biotechnology
16MTB22D1

L T
4 0

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

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

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. Cryopreservation, 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. Genetic diagnostic methods and microarray technology

UNIT- IV

Tissue and organ transplant, vaccines & peptide vaccines, Proteins as therapeutic agents, Applications, delivery and targeting of the 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, 2nd Edition. ASM press Washington DC.
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
16MTB22D2

L T
4 0

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

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

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).
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^{2nd} SEMESTER (Bio–Tech.)
Protein Engineering
16MTB22D3

L T
4 0

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

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

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 TE Creighton, Protein structure: A practical approach, 2nd Edition, Oxford university press, 1997.
2. Edited by TE Creighton, Protein function. A practical approach, 2nd Edition, Oxford university press, 1997.

3. Edited by TE Creighton, Protein function. A practical approach. Oxford university press. 2004.
4. Cleland and Craik, Protein Engineering, Principles and Practice, Vol7, Springer Netherlands 1998. Press, 2006.
5. Mueller and Arndt., Protein engineering protocols, 1st Edition, Human a 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.

M. Tech. 2nd SEMESTER (Bio-Tech.)
Biotechnology Lab - 1
16MTB22CL1

L T P
0 0 4

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

Lab Course– I (Based on 16MTB22C1) work to be carried out as per 16MTB22C1

- Basics of sequence analysis Retrieval of sequence-nucleic acid/Protein
- Local and Global Alignment-concepts Pairwise 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 comparison
- Protein-Protein interactions
- Docking small molecules/peptides in active site of protein. Use of automated docking procedures. Free energy calculation.
- Find transcription regulatory signals
- System-wide analyses tools and techniques

Reference Books:

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

M.Tech.2ndSEMESTER(Bio–Tech.)
Biotechnology Lab – II
16MTB22CL2

L T P
0 0 4

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

Laboratory -II work to be carried out as per 16MTB22C2

M. Tech. 2nd SEMESTER (Bio-Tech.)
Biotechnology Lab – III
16MTB22CL3

L T P
0 0 4

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

Laboratory - III work to be carried out as per 16MTB22C4

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

S.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	17MTB23C1	Plant Biotechnology & Crop Improvement	4	0	-	4	50	100	-	150	3	4
2	17MTB23C2	Biochemical Engineering	4	0	-	4	50	100	-	150	3	4
3	17MTB23D1 or 17MTB23D2 or 17MTB23D3	Elective-I	4	0	-	4	50	100	-	150	3	4
4	17MTB23D4 or 17MTB23D5 or 17MTB23D6	Elective-II	4	0	-	4	50	100	-	150	3	4
5	17MTB23C3	Lab Course I (Based on 17MTB23C1)	-	-	2	2	50	-	50	100	3	4
6	17MTB23C4	Lab Course II (Based on 17MTB23C2)	-	-	2	2	50	-	50	100	3	4
7	17MTB23C5	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:

17MTB23D1 Stem Cells in Healthcare
17MTB23D2 Bio-Nanotechnology
17MTB23D3 Clinical Genetics & Counselling

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

17MTB23D4 Intellectual Property Rights
17MTB23D5 Advances in Applied Biotechnology
17MTB23D6 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

S. 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	17MTB24C1	Dissertation Phase II	0	0	14	14	100	-	400	500	-	28
		TOTAL	14									

M. Tech 3rd Semester (Bio-Tech.)
Plant Biotechnology & Crop Improvement
17MTB23C1

L T
4 0

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

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

Genetic engineering of plants: production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other a biotic 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 nutraceuticals 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
17MTB23C2

L T
4 0

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

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 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 GV, 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, McGraw-Hill
- Process Equipment Design, Joshi, M.V., Mahajani, V.V., Macmillan India Ltd.
- Parry's Chemical Engineer's Handbook, 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 ML, Kargi F, 2nd ed, Prentice Hall of India Ltd.

M. Tech^{3rd}Semester (Bio–Tech.)

Stem Cells in HealthCare

17MTB23D1

L T
4 0

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

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

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. EmbryonicStemcellsbyKursadandTurksen.2002.HumanaPress.
2. Stemcellandfutureofregenerativemedicine.BycommitteeontheBiologicalandBiomedical applications of Stem Cell Research. 2002. National Academic press

M. Tech3rdSemester (Bio–Tech.)
Bio-Nanotechnology
17MTB23D2

L T
4 0

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

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

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 Tweezers, Nano-manipulation, UPS (UV Photoelectron 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.
3. Neelina H. Malsch, Biomedical Nanotechnology, 1st Edition, CRC Press, 2005
4. Sharon, M. & Sharon, M (2012) Bio-Nanotechnology- Concepts and Applications, CRC Press.
5. David E. Reisner (2008) Bionanotechnology-Global Prospects, CRC Press.
6. 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
17MTB23D3

L T
4 0

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

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

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, peroxisomal 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, Pharmacogenomics.

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. Pasternak, An Introduction to Molecular Human Genetics: Mechanism so f Inherited Diseases, 2nd Edition, Fritzgarald, WileyLiss, 2005.
3. Iankowski and Polak, Clinical Gene Analysis and Manipulation: Tools, Techniques and Troubleshooting, Cambridge University Press, 1996.

M. Tech 3rd Semester (Bio–Tech.)

Intellectual Property Rights

17MTB23D4

L T
4 0

Theory : 100 Marks

Sessional: 50 Marks

Total : 150 Marks

Credits : 4

Time : 3Hrs.

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 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/ReferenceBooks:

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
17MTB23D5

L T
4 0

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

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

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" Human a Press.
2. Pennington, S. 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.)

Bio ethics and Biosafety

17MTB23D6

L T
4 0

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

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

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 germline 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/ReferenceBooks:

1. Biological Safety: Principles and 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 Tzotzos (May, 1995)
4. Biological Safety Manual by Yale University.
5. Richard Sherlock & J D Morrey. Ethical Issues in Biotechnology, 2002

M. Tech 3rd Semester (Bio-Tech.)

Lab Course I

17MTB23C3

L T P

0 0 4

Exam: 50Marks

Sessional: 50Marks

Total: 100Marks

Credits : 2

Lab Course I work to be carried out as per 17MTB23C1

M. Tech 3rd Semester (Bio–Tech.)
Lab Course II
17MTB23C4

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

L T P
0 0 4

Lab Course II work to be carried out as per 17MTB23C2

M. Tech 3rd Semester (Bio-Tech.)
Dissertation Phase I
17MTB23C5

L T P
0 0 8

Sessional: 100Marks
Total: 100 Marks
Credits : 4

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

L T P
0 0 14

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