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.

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

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

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. Alberts*et 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
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

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

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

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.*

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

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.

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.

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.

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.
7. 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.

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.

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.

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
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.

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.
2. Edited by T E Creighton, Protein function. A practical approach, 2nd Edition, Oxford university press, 1997.

3. Edited by T E Creighton, Protein function. A practical approach. Oxford university press. 2004.
4. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands 1998.Press, 2006.
5. Mueller and Arndt., Protein engineering protocols, 1st Edition, Humana Press, 2006.

6. Ed. Robertson DE, Noel JP, Protein Engineering Methods in Enzymology, 388, Elsevier Academic Press, 2004.

7. J Kyte, Structure in protein chemistry, 2nd Edition, Garland publishers, 2006.

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.
- Finding transcription 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.

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

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