

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 Credi ts	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
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

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 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., Grissem 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

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, McGraw- 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.Ladisich, 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

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

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, 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

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, 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. 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

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
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

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
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

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

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

Lab Course II

17MBT23C4

L T P
0 0 4

Exam : 50 Marks

Sessional : 50 Marks

Total : 100 Marks

Credits : 2

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

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

L T P
0 0 8

Sessional : 100 Marks
Total : 100 Marks
Credits : 4

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