

**MAHAKAUSHAL UNIVERSITY,  
JABALPUR M.P.**

**Approved by Higher Education  
And the Governor of M.P.**



**Faculty of Science  
Scheme & Syllabus  
For  
Subject –Biotechnology  
M.Sc. Programme  
(1 Year PG Diploma/ 1 Year PG/ 2Year PG)  
Program  
I to IV Semester  
2025-26**

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I Semester I</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0101-T	
<b>2</b>	<b>Course Title</b>	Biochemistry and Analytical Techniques	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p>To create general understanding about Biochemistry and Analytical Techniques.</p> <ol style="list-style-type: none"> <li>1. To provide the insights of the macromolecules involved in the structure and function of a cell.</li> <li>2. To apply the knowledge of metabolic pathways in production of commercially important products.</li> <li>3. To apply the knowledge of metabolic pathways to solve physiological and molecular aspects.</li> <li>4. To enable the students to acquaint with basic principle, instrumentation, procedure, and applications of various classical as well as sophisticated biochemical techniques.</li> <li>5. To develop competence in various chromatographic and electrophoresis techniques and apply them in isolating and characterizing different biological molecules.</li> <li>6. To provide information on fundamental laws relating to photochemistry and applications of UV-visible, fluorescence and IR spectrophotometry in analytical determination and characterization of biomolecules.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

Part B Content of the Course		
Total Number of Lecture Hours – 90		
Unit	Topics	No of Lecture Hours
I	<p>Study traditional enzymatic treatments mentioned in texts like <i>Charaka Samhita</i> and correlate them with modern enzymology (e.g., digestion-related enzymes like <i>amylase</i>, <i>lipase</i>). Structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin etc.; Enzymology: Physico-chemical characterization &amp; classifications, nomenclature of enzymes, Enzyme kinetics, Mechanism of enzyme catalysis and inhibition</p> <p>Proteins - classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran maps, Tools to characterize expressed proteins.</p> <p><b>Activity:</b> Write-up on contribution of Dr. Ramachandran in Biochemistry.</p> <p><b>Key words:</b> Enzyme kinetics, Ramachandran maps, Purification, Chymotrypsin.</p>	18
II	<p>Nucleic acids-DNA Structure; Replication; Repair &amp; Recombination Structure of DNA - A-,B-, Z- and triplex DNA; Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Gene stability and DNA repair- enzymes; Recombination: Homologous and non-homologous; Site specific recombination; Gene targeting; Gene disruption.</p> <p><b>Activity:</b> Use indigenous plant extracts (e.g., papaya, neem, turmeric) to explore their potential in DNA extraction or as cell-lysing agents.</p> <p><b>Key words:</b> Replication, Recombination, DNA repair, Gene disruption.</p>	18
III	<p>Post Transcriptional Modifications, RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA. RNA splicing: Nuclear splicing</p> <p>Translation &amp; Transport Translation machinery; Ribosomes; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and</p>	18

	<p>post-translational modifications; Genetic code in mitochondria; Transport of proteins and molecular chaperones.</p> <p><b>Activity:</b> Group discussion on Concept of Hereditary through DNA and regulation of transcription (Gene Expression).</p> <p><b>Key words:</b> Post transcriptional and translational modifications</p>	
IV	<p>Analytical techniques:</p> <p>Cell disruption techniques: Mechanical and non-mechanical methods of cell disruption; Separation techniques: Centrifugation: basic principle, components, Types: differential velocity, density gradient; difference in g value and RCF; applications of preparative and analytical centrifugation.</p> <p>Chromatography Techniques Chromatography Techniques: Modes: Column, TLC and Paper chromatography; Principle; components; working and applications of - Adsorption, Gel permeation, Ion exchange, Partition, Affinity chromatography. Electrophoretic techniques: Theory and application of gel electrophoresis.</p> <p><b>Activity:</b> Isolation, separation and purification techniques in Ayurveda (Rasashastra) .</p> <p><b>Key words:</b> Cell disruption, Adsorption, Affinity chromatography, Gel electrophoresis.</p>	18
V	<p>Spectroscopy Techniques: Basic principle of light absorption; Jablonski diagram; Principle; components; working and applications of UV-visible spectroscopy, Atomic absorption Spectroscopy.</p> <p>Microscopy: Basic principle; factors affecting image formation and magnification; components, working, types: light, phase contrast, fluorescence microscopy; Electron microscopy: TEM, SEM.</p> <p><b>Activity:</b> Debate or write-up on how ancient Indian theories of light relate to absorption and emission in spectroscopy.</p> <p><b>Key Words:</b> Fluorescence microscopy, Electron microscopy, UV-visible spectroscopy.</p>	18

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### Suggested Readings –

1. V. Voet and J.G. Voet, Biochemistry, latest edition, John Wiley, New York,.
2. A.L. Lehninger, Principles of Biochemistry, latest edition, W.H Freeman and Company.
3. L. Stryer, Biochemistry, 5th edition, W.H. Freeman and Company, 2002. 4. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, latest Edition, W.H. Freeman & Company, San Fransisco.
- 5 Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, latest Edition, Cambridge University Press.
6. D. Holme & H. Peck, Analytical Biochemistry, latest Edition, Longman.
7. R. Scopes, Protein Purification - Principles & Practices, latest Edition, Springer Verlag.
8. JL Jain, Nitin Jain, Sunjay Jain. Fundamentals of Biochemistry. S Chand Publishers.
9. Rajan Katoch. Analytical Techniques in Biochemistry and Molecular Biology. Springer-Verlag Publisher.

#### Suggested digital platforms web links

[mcdwebarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm](http://mcdwebarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm) [www.biochemweb.org/](http://www.biochemweb.org/)  
<http://golgi.harvard.edu/biopages.html>  
[webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-](http://webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-)

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods:- (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)-</b> Five very short answer question (20 words each) <b>Section (B)-</b> Five short answer question (200 words each) <b>Section (C)-</b> Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II Year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I Semester I</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0102-T	
<b>2</b>	<b>Course Title</b>	Cell and Molecular Biology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>Course Objectives:</b> To create general understanding about Plant and Animal Biotechnology</p> <ol style="list-style-type: none"> <li>1. To have detailed understanding of various processes including cell division, signal transduction pathways and regulation of overall structure and function of the cells.</li> <li>2. To know about the developmental processes at molecular level in model organisms.</li> <li>3. To apply the knowledge in knockout and knocking in of the genes and understanding of the polygenic diseases.</li> <li>4: To enable students to comprehend the structure and function of nucleotides and the basics of genome organization.</li> <li>5. To provide detailed understanding of the DNA replication, transcription, translation, protein folding and sorting as well as their regulation, respectively.</li> <li>6. To develop understanding that how errors in the above mentioned processes can cause several problems in living systems and how we can develop some tactics to reverse them.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

<b>Part B Content of the Course</b>		
<b>Total Number of Lecture Hours – 90</b>		
<b>Unit</b>	<b>Topics</b>	<b>No of Lecture Hours</b>
<b>I</b>	<p>Ayurvedic concepts of Beeja (seed), Beeja-bhaga (chromatin), and Beeja-bhagavayava (gene) in context to molecular biology and cell division. Membrane Structure and Function Structural models; Composition and dynamics; Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis; Membrane carbohydrates and their significance in cellular recognition; Cellular junctions and adhesions; Structure and functional significance of plasmodesmata.</p> <p><b>Activity:</b> Discussion on the contribution of Indian cell and molecular Biologists.</p> <p><b>Key words:</b> Transportation of molecules, Endocytosis, Plasmodesmata.</p>	18
<b>II</b>	<p>Organelles Nucleus – Structure and function of nuclear envelope, lamina and nucleolus; Macromolecular trafficking; Chromatin organization and packaging; Cell cycle and control mechanisms; Mitochondria – structure, organization of respiratory chain complexes, ATP synthase, Structure-function relationship; Mitochondrial DNA and male sterility; Origin and evolution; Chloroplast– Structure-function relationship; Chloroplast DNA and its significance; Chloroplast biogenesis; Origin and evolution.</p> <p><b>Activity:</b> A glimpse of Scientific Journey of Dr. Jagadish Chandra Bose.</p> <p><b>Key words:</b> Chromatin organization, Chloroplast, Mitochondria, ATP synthase.</p>	18
<b>III</b>	<p>Cell cycle – Molecular events and model systems; Control mechanism; Apoptosis.</p> <p>Cellular basis of differentiation and development - mitosis, gametogenesis and fertilization, development Arabidopsis; Spatial and temporal regulation of Gene Expression Differentiation of Specialized Cells Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Cellular basis of immunity.</p>	18

	<p><b>Activity:</b> Concept of Rasa Dhatu and Rakta Dhatu in Ayurveda and relate them to blood and immune cells.</p> <p><b>Key Words:</b> Gene Expression, Arabidopsis, Differentiation, Blood cells.</p>	
IV	<p>Cancer: Biology of cancer; properties and features of cancer cells; oncogenes; tumor suppresser genes; mechanism of cancer; metagenesis; types of cancer Genes, Mutation and Mutagenesis: UV and chemical mutagens; Types of mutation; Ames test for mutagenesis; Methods of genetic analysis.</p> <p>Differentiation of cancerous cells and role of proto-oncogenes; Phase changes in Salmonella; Mating cell types in yeast; Surface antigen changes in Trypanosomes; Heterocyst differentiation in Anabaena; Sex determination in Drosophila.</p> <p><b>Activity:</b> Seminar on traditional Indian views of immune health and parallels with cancer suppression.</p> <p><b>Key words:</b> Metagenesis, Mutagenesis, proto-oncogenes, Drosophila.</p>	18
V	<p>Stem cells-Introduction Definition and basics of stem cells, Classification of stem cells – different types of stem cells human embryonic stem cells, adult stem cells etc.Sources of Stem cells Fetus and various adult tissues. Advantages of stem cells.</p> <p><b>Activity:</b> Explore the idea of tissue regeneration through Rasayana therapy and its conceptual overlap with stem cell therapy.</p> <p><b>Key words:</b> Embryonic stem cells, Adult stem cells, Fetus.</p>	18

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### Suggested Readings –

1. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
2. Smith & Wood, Cell Biology, latest Edition, Chapman & Hall, London.
3. Watson et al., Molecular Biology of the gene, latest Edition, Pearson Prentice Hall. USA.
4. B. M. Turner, Chromatin & Gene regulation, latest Edition, Wiley-Blackwell.
5. Benjamin Lewin, Gene IX, latest edition, Jones and Barlett Publishers.
6. Robert Lanja, Essential of Stem Cell Biology, latest Edition, academic Press.
7. P.K. Gupta. Cell and Molecular Biology (5 Edition).

#### Suggested digital platforms web links

<https://www.doegenomestolife.org/>

<https://mitocw.ups.edu.ec/courses/>

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I</b> <b>Semester I</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0101-P	
<b>2</b>	<b>Course Title</b>	Biochemistry and Analytical Techniques	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	<p>The overall course outcome is that the student shall develop deeper understanding of biochemical estimations using different techniques. The student shall be able to:</p> <ol style="list-style-type: none"> <li>1. Learn quantitative analysis test of carbohydrates, amino acids and proteins</li> <li>2. Understand the working of UV spectrophotometry, Fluorimetry, FT-IR and justify its application in drug analysis</li> <li>3. Classify the chromatographic separation methods and choose appropriate technique for analysis of biomolecules</li> <li>4. Design methods for performing quantitative &amp; qualitative analysis of biomolecules and drugs using various analytical instruments</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<u><b>List of Practical</b></u> 1. To prepare an Acetic-Na Acetate Buffer system and validate the Henderson-Hasselbach equation. 2. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law. 3. Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by TLC.	Total 120

<p>4. Urea-SDS PAGE for separation of low molecular weight proteins.</p> <p>5. Separation of Cell organelles by centrifugation</p> <p>6. Use of marker enzyme assays for organelles</p> <p>7. AN ENZYME PURIFICATION THEME (such as E.Coli Alkaline phosphatase or any enzyme of the institutions choice).</p> <p>(a) Preparation of cell-free lysates</p> <p>(b) Ammonium Sulfate precipitation</p> <p>(c) Ion-exchange/Gel/Affinity Chromatography</p> <p>(d) Generating a Purification Table</p> <p>(g) Assessing purity by SDS-PAGE Gel Electrophoresis.</p> <p>8. Demonstration of gel Filtration chromatography</p> <p>9. Demonstration of Ion exchange chromatography</p> <p>10. Demonstration of High performance Liquid chromatography (HPLC)</p>	
<p><b>Part C Learning Resources</b></p>	
<p><b>Text Books, Reference Books ,Other Resources</b></p>	
<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Biochemical Techniques (A Practical Approach): Dr. K. Tarakaram, Prof. K.N. Jayaveera, Himalaya Publishing House Pvt. Ltd.</li> <li>2. Practical Biochemistry, Editor(s) : Pamela Jha. DOI: 10.2174/97898151658521240101</li> <li>3. Analytical Biochemistry and Separation Techniques, Dr. P. Palanivelu, Twentyfirst Century Publications</li> </ol> <p><b>Virtual lab links:</b>  <a href="https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering">https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering</a>  <a href="https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering">https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering</a></p>	
<p><b>Suggested equivalent online courses :</b></p>	

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

<b>Part A Introduction</b>			
<b>Program: PG II year</b>	<b>Class: M.Sc.</b>	<b>Year: I</b> <b>Semester I</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0102-P	
<b>2</b>	<b>Course Title</b>	Lab on Cell and Molecular Biology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or Allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	After finishing this lab work, student will be able to: <ol style="list-style-type: none"> <li>1. use standard lab equipment and techniques common in cell and molecular biology, such as microscopy, DNA extraction, PCR, gel electrophoresis</li> <li>2. to communicate scientific findings effectively, in written form (e.g., lab reports)</li> <li>3. design and conduct experiments to test hypotheses and address research questions in cell and molecular biology.</li> <li>4. to critically evaluate scientific literature and research findings.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<b><u>List of Practicals :</u></b> <ol style="list-style-type: none"> <li>1. Separation of cell organelles</li> <li>2. Marker enzyme assay for seeing activity of separated organelle.</li> <li>3. Isolation of DNA from bacterial cells</li> <li>4. Isolation of plasmid DNA</li> <li>5. Agarose gel electrophoresis of DNA.</li> <li>6. Transfer of DNA from gel – Southern Blotting.</li> <li>7. Transfer of RNA from gel – Northern Blotting.</li> </ol>	Total 120

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|--|--|
| <ol style="list-style-type: none"> <li>8. Bacterial Transformation (Selection of transformants with Blue-white selection)</li> <li>9. Polymerase Chain Reaction</li> <li>10. . Radiation induced genetic damage assessment (Root meristem of <i>Allium cepa</i>).</li> <li>11. Chemical induced genetic damage assessment (Root meristem of <i>Allium cepa</i>).</li> <li>12. Preparation of metaphase chromosomes form blood.</li> <li>13. G-banding and karyotyping.</li> <li>14. Restriction digestion of DNA</li> <li>15. Thermal Denaturation of DNA and UV absorption studies</li> </ol> |  |
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### **Part C Learning Resources**

#### **Text Books, Reference Books ,Other Resources**

##### **Suggested Readings –**

1. CELL AND MOLECULAR BIOLOGY (A Practical Approach)by S. Kannan & N. Kayalvizhi , MJP Publishers
2. CELL AND MOLECULAR BIOLOGY : A LAB MANUAL by CHAITANYA, K. V. eBook ISBN : 9789354432613
3. Practical Guide Of Cell Biology & Molecular Genetics by Dr. Kanak Saxena, AISECT Publications

##### **Virtual Lab Links:**

1. <https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

##### **Suggested equivalent online courses :**

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I Semester II</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0201-T	
<b>2</b>	<b>Course Title</b>	Environmental Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p>After studying this course, the student will be able to:</p> <p>1: address the issues of environmental changes, pollution and talk about the biotechnological solutions.</p> <p>2: Be aware of the types and source of pollution.</p> <p>3: Identify the toxic chemicals and their biochemical aspects in environment, their mode of entry and carcinogenicity.</p> <p>4: Explain biogeochemical factor in environmental health.</p> <p>5: Be aware of uses and preparation of biopesticides, biofertilizers, etc. CO6: Students will be able to find novel solutions for the climate change and pollution.</p>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

<b>Part B Content of the Course</b>		
<b>Total Number of Lecture Hours – 90</b>		
<b>Unit</b>	<b>Topics</b>	<b>No of Lecture Hours</b>
<b>I</b>	<p>Concept of Prayavaran in Indian knowledge system.</p> <p>Environment: Basic concepts and issues Environmental Pollution: types of pollution, Methods for the measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations.</p> <p>Key words: Pollution, Environmental management.</p> <p>Activity: Use of flora and fauna as natural indicators of pollution.</p>	18
<b>II</b>	<p>Air pollution and its control through Biotechnology. Water Pollution and Its Control: Water as a scarce natural resource, Need for water management, Measurement of water pollution, sources of water pollution, Waste water collection, Waste water treatment -physical, chemical and biological treatment processes.</p> <p>Key Words: Water management, Waste water treatment, Biological treatment process.</p> <p>Activity: Water management systems in ancient India.</p>	18
<b>III</b>	<p>Microbiology of Waste Water Treatments: Aerobic Process: Activated sludge, Oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic Processes: Anaerobic digestion, anaerobic filters. Upflow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, Sugar, antibiotic industries.</p> <p><b>Key words:</b> Anaerobic digestion, Oxidation ponds, Treatment schemes, Distillery.</p> <p><b>Activity:</b> Use of plants such as Neem, Tulsi and Aloe vera for antimicrobial and detoxifying effects in water bodies.</p>	18
<b>IV</b>	<p>Microbiology of degradation of Xenobiotics in Environment . Ecological considerations, decay behaviour &amp; degradative plasmids; Hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Bioremediation of contaminated soils and waste land. Biopesticides in integrated pest management.</p> <p>Key words: Hydrocarbons, Oil pollution, Bioremediation, Degradative plasmids.</p>	18

	Activity: Assignment on natural decomposition processes used traditionally.	
V	<p>Solid wastes: sources and management (composting, wormiculture and methane production). Global Environmental Problems: Ozone depletion, UV-B, green -house effect and acid rain, their impact and biotechnological approaches for management.</p> <p>Key Words: Ozone depletion, Green -house effect, Acid rain, Biotechnological management.</p> <p>Activity: Waste segregation, composting and recycling practices in rural settings of India.</p>	18

### Part C Learning Resources

#### Text Books, Reference Books, Other resources

1. Bruce E. Rittmann, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, Second Edition 2nd Edition.
2. M.H. Fulekar. Environmental Biotechnology. CRC Press.
3. P. Parihar. Environmental Biotechnology: Fundamentals and Applications. Agrobios.
4. Ranbir Chander Sobti, Naveen Kumar Arora, Richa Kothari: Environmental Biotechnology: For Sustainable Future, Springer nature
5. Sukanta Mondal, Shivesh Pratap Singh, Yogendra Kumar Lahir: Emerging Trends in Environmental Biotechnology, CRC Press
6. Neetu Sharma, Abhinashi Singh Sodhi, Navneet Batra: Basic Concepts in Environmental Biotechnology, CRC Press
7. Environmental Biotechnology – Basic concepts and applications, Indu Shekhar Thakur, I K International publications

#### Suggested digital platforms web links

<https://www.teriin.org/sites/default/files/2020-11/2018EE03-%20Course%20material.pdf>

<http://egyankosh.ac.in/handle/123456789/95583>

<https://www.infobooks.org/pdfview/environmental-biotechnology-sathyabama-337/>

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II Year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I Semester II</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0202-T	
<b>2</b>	<b>Course Title</b>	Advanced Plant and Animal Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>Course Objectives:</b> To create advanced understanding about Plant and Animal Biotechnology</p> <p>1: Acquaint with principles, technical requirement, scientific and commercial applications in plant biotechnology.</p> <p>2: Support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic tools.</p> <p>3: Become motivated to set goals towards pursuing higher level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries.</p> <p>4: Students will learn about the concept of new gene transfer in animal cell culture techniques and associated medical implications.</p> <p>5: Students will have strengthened bio-medical research from basic research to the modern drug discovery.</p>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

<b>Part B Content of the Course</b>		
<b>Total Number of Lecture Hours – 90</b>		
<b>Unit</b>	<b>Topics</b>	<b>No of Lecture Hours</b>
<b>I</b>	<p>Ancient Indian insights on embryology (Garbha Upanishad) and their philosophical relevance to developmental biology.</p> <p>Protoplast Culture and Somatic Hybridization, Protoplast isolation; Culture and usage; Somatic hybridization – methods and applications; Cybrids and somatic cell genetics.</p> <p>Measurement of viability and cytotoxicity. Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; culture, maintenance of cell culture; cell separation. Disaggregation of tissue and primary culture, maintenance of cell culture; cell separation.</p> <p>Key words: Viability, Cytotoxicity, Cybrids, Cell separation, Mammalian cell culture.</p> <p>Activity: Assignment on endangered plants used ayurvedic preparations such as Chayvanprash.</p>	18
<b>II</b>	<p>Genetic Engineering for Plant Architecture and Metabolism, Seed storage proteins; Proteins engineering; Vitamins and other value addition compounds; Source- sink relationships for yield increase; Post-harvest bioengineering; Concept of biofactories; Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation.</p> <p>Key words: Biofactories, Bioenergy, Concept of biofactories, Source-sink relationships.</p> <p>Activity: Debate on the comparison of traditional metabolite extraction methods versus modern recovery methods from recombinants.</p>	18
<b>III</b>	<p>Plant Genomics, Identification of candidate genes using genetic information (positional cloning), using biochemical and expression analysis (microarray analysis, proteomics, metabolomics); Characterization and functional analysis of candidate genes: transformation, mutant populations, knockout system; Heterologous expression systems; Protein analysis; Bioinformatics and database; Plant</p>	18

	<p>genetic resources; Patenting of biological material; Plant breeders rights(PBRs) and farmers right; Biosafety and containment practices.</p> <p>Key words: Plant breeder’s rights, Bioinformatics, Database, Microarray analysis, Transformation.</p> <p>Activity: Debate on Bioethics in ancient India and in present time.</p>	
<b>IV</b>	<p>Types of stem cells-Totipotent, pluripotent, oligopotent, multipotent, unipotent; Embryonic stem cell culture, Induced pluripotency, Molecular mechanisms of stem cell maintenance, Role of protooncogenes and tumor suppressor genes in maintenance of stem cells and senescence, Models of cancer stem cells development.</p> <p>Key words: Stem cell maintenance, Tumor suppressor genes, Embryonic stem cell, Cancer stem cells.</p> <p>Activity: Literature survey on ancient wound healing practices.</p>	18
<b>V</b>	<p>Application of stem Cells, Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson’s, Alzheimer, Spinal Code Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia etc.</p> <p>Key words: Parkinson’s disease, Alzheimer’s disease, Liver failure, Cancer, Cardiomyopathy.</p> <p>Activity: Traditional knowledge to enhance memory, reduce aging effects and to treat degenerative diseases.</p>	18

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### Suggested Readings –

1. Ed. John R.W. Masters, Animal Cell Culture – Practical Approach, 3rd Edition, Oxford university Press, 2000
2. Ed. Martin, Clynes Animal Cell Culture Techniques, Springer, 1998
3. A. Puller (ed), Genetic Engineering in Animals, VCH Publishers.
4. Textbook of Animal Biotechnology, B.Singh, SK Gautam, MS Chouhan, SK Singla, TERI press
5. Animal Biotechnology, R Sasidhara, MJP Publishers.
6. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plant, latest Edition, Oxford University Press.
7. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.
8. Introduction to Plant Biotechnology, HS Chawla, 4th edition, 2024
9. PLANT BIOTECHNOLOGY, 4TH EDITION, BD Singh, 2022.
10. Ann A.Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
11. Peter J.Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
12. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006.
13. A.D.Ho., R.Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
14. C.S.Potten, Stem Cells, Elsevier, 2006.

#### Suggested digital platforms web links

<https://epdf.pub/plant-biotechnology.html>

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods:- (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks</p> <p>20 Marks</p> <p><b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)-</b> Five very short answer question (20 words each) <b>Section (B)-</b> Five short answer question (200 words each) <b>Section (C)-</b> Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i></p> <p><b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i></p> <p><b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i></p> <p><b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: I</b> <b>Semester II</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0201-P	
<b>2</b>	<b>Course Title</b>	Lab on Environmental Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	<ol style="list-style-type: none"> <li>1. Develop students' skills in the design, implementation, and interpretation of experiments related to environmental biotechnology applications</li> <li>2. Develop students' skills for physicochemical quality assessment of wastewater for planning monitoring programmes for pollution prevention</li> <li>3. Demonstrate and quantify the physiological parameters for waste water treatment and discharge</li> <li>4. Communicate scientific information related to environmental biotechnology in oral and written formats, including the preparation of laboratory reports</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<ol style="list-style-type: none"> <li>1. Estimation of Biochemical Oxygen Demand (BOD).</li> <li>2. Estimation of Chemical Oxygen Demand (COD).</li> <li>3. Isolation and Characterization of Pollutant-Degrading Microorganisms.</li> <li>4. Wastewater Treatment Using Activated Sludge or Microbial Consortia.</li> </ol>	Total 120

- |   |  |
|---|--|
| <p>5. Estimation of Heavy Metals in Soil/Water Samples by AAS or Colorimetry.</p> <p>6. Biosorption of Heavy Metals Using Microbial or Agricultural Biomass</p> <p>7. Vermicomposting of Organic Waste</p> <p>8. Phytoremediation Studies Using Metal-Accumulating Plants</p> <p>9. Estimation of Chlorine demand in the wastewater sample</p> <p>10. Estimation of Total suspended solids in the wastewater sample</p> <p>11. Quantitative estimation of nitrates in the wastewater sample</p> <p>12. Quantitative estimation of phosphates in the wastewater sample</p> |  |
|---|--|

### **Part C Learning Resources**

#### **Text Books, Reference Books ,Other Resources**

**Reference books:**

1. Jayanta Kumar Patra , Gitishree Das , Swagat Kumar Das , Hrudayanath Thatoi: A Practical Guide to Environmental Biotechnology, Springer Nature

**Suggested web links:**

[https://buisapi.brainwareuniversity.org.in/upload/classnote/1234\\_Lab%20Manual\\_BBTD594B.pdf](https://buisapi.brainwareuniversity.org.in/upload/classnote/1234_Lab%20Manual_BBTD594B.pdf)

**Virtual Lab Links:**

<https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>

<https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

**Suggested equivalent online courses :**

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

<b>Part A Introduction</b>			
<b>Program: PG II year</b>	<b>Class: M.Sc.</b>	<b>Year: I</b> <b>Semester II</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0202-P	
<b>2</b>	<b>Course Title</b>	Lab on Advanced Plant and Animal Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or Allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	<p>On successful completion of the course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Learn about plant tissue culture techniques and secondary metabolites production.</li> <li>2. Learn about transgenesis and molecular markers.</li> <li>3. Learn about animal tissue culture techniques</li> <li>4. Learn about transgenic animals and gene therapy.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<ol style="list-style-type: none"> <li>1. Electroelution of insert DNA from agarose gel slice.</li> <li>2. Mobilization of recombinant Ti plasmid from common laboratory host (E. coli) to an <i>Agrobacterium tumefaciens</i> strain</li> <li>3. <i>Agrobacterium tumefaciens</i>-mediated plant transformation</li> <li>4. Direct DNA delivery to plant by Particle Bombardment.</li> <li>5. Isolation of plant genomic DNA by modified CTAB method</li> <li>6. Molecular analysis of putative transformed plants by Polymerase Chain Reaction</li> </ol>	Total 120

7. Mammalian cell transfection.	
8. Bacterial transformation and gene cloning.	
9. Staining techniques for toxicity and viability determination.	
10. Measurement of cell death.	
11. Transwell migration and scratch assays.	
12. Cryopreservation and revival of cell lines	

**Part C Learning Resources**

**Text Books, Reference Books ,Other Resources**

**Suggested Readings –**

1. Bhojwani, S.S. & Razdan, (2004). Plant Tissue culture and Practice
2. Brown, T.A. (2016). Gene cloning and DNA analysis: An introduction. 7th edition.  
Blackwell Publication
3. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing

**Virtual Lab Links:**

1. <https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

**Suggested equivalent online courses :**

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

## PG II YEAR BIOTECHNOLOGY

### SEMESTER III

<b>Part A Introduction</b>			
<b>Program: 2 year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II Semester III</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0301-T	
<b>2</b>	<b>Course Title</b>	Bioprocess Engineering and Technology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<b>Course Objectives:</b> To create general understanding about Industrial Biotechnology and Bioprocess engineering  1. Knowledge of industrial applications of biotechnology and tactics to convert lab scale to industry scale production of commercially important products. 2. To understand the bioprocess engineering, basic techniques, methods, functions and industrial products. 3. To know the different microorganisms and their products (enzymes, polymers, metabolites, etc.) that are used in the biotech industry	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

Part B Content of the Course		
Total Number of Lecture Hours – 90		
Unit	Topics	No of Lecture Hours
I	<p>Explore native microbial cultures used in Ayurveda and traditional medicine.</p> <p>Basic principle of Biochemical Engineering-Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.</p> <p><b>Activity:</b> Isolation and screening of microbes from traditional food preparations.</p> <p><b>Key words:</b> Biochemical engineering, Growth and death kinetics, Strain improvement.</p>	18
II	<p>Concepts of basic mode of fermentation processes-Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation - Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design – mechanically agitated; Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.</p> <p><b>Activity:</b> Case studies on fermented foods like idli, dosa, pickles, curd, and kanji.</p> <p><b>Key words:</b> Fermentation, Fermenter design, Upstream processing, Scale up.</p>	18
III	<p>Downstream processing: Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction;</p>	18

	<p>Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.</p> <p><b>Activity:</b> Debate on indigenous essential oil extraction using cold pressing and steam distillation.</p> <p><b>Key words:</b> Centrifugation, Reverse osmosis, Crystallization, Treatment of effluent.</p>	
IV	<p>Applications of enzymes in food processing, Mechanism of enzyme function and reactions in process techniques; Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Interesterified fat; Hydrolyzed protein etc. and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase, beer mashing and chill proofing; cheese making by proteases and various other enzyme catalytic actions in foodprocessing.</p> <p>Applications of Microbes in food process operations and production, Fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods.</p> <p><b>Activity:</b> Document traditional bioprocessing methods used in rural India.</p> <p><b>Key words:</b> Enzyme function, deoxygenation, proteases, High-Fructose Corn Syrup, Hydrolyzed protein.</p>	18
V	<p>Production, recovery and scaling up of enzymes and their role in food and other industries; Immobilization of enzymes and their industrial applications. Enzyme Technology- production, recovery, stability and formulation of bacterial and fungal enzymes- amylase, protease, penicillin acylase, glucose isomerase; Cell based biotransformations - steroids, antibiotics, alkaloids, enzyme/cell electrodes.</p> <p><b>Activity:</b> Indigenous use of fermented cereals and legumes for digestive health.</p> <p><b>Key words:</b> Enzyme Technology, Fungal enzymes, Glucose isomerise, Cell based bio-transformations.</p>	18

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### **Suggested Readings –Texts/References: Bioprocess Engineering and Technology**

1. Crueger and A Crueger, Biotechnology: A textbook of Industrial Microbiology, Sinauer Associates, 1990.(English Ed., TDW Brock);
2. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd edition, McGraw-Hill Book Co., New York, 1986.
3. Young M.M., Comprehensive Biotechnology: The Principles, applications and regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Reed Elsevier India Private Ltd, India, 2004.
4. BIOPROCESS ENGINEERING: BASIC CONCEPTS, 2ND Edition, Michael L. Shuler / Fikret Kargi (2013).
5. Priti Patel, Khushbu Panchal. Bioprocess Technology-Fundamental of Microbial Process. Scholars' Press Publisher.

#### **Suggested digital platforms web links**

<https://www.bioprocessengineeringonline.com/bioprocess-engineering-courses>

[https://api.pageplace.de/preview/DT0400.9780132901406\\_A29420225/preview-9780132901406\\_A29420225.pdf](https://api.pageplace.de/preview/DT0400.9780132901406_A29420225/preview-9780132901406_A29420225.pdf)

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

Recommended Continuous Assessment Methods:- (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b> ) <b>Maximum Marks: 100</b> Continuous Comprehensive Evaluation (CCE): 40 Marks University Examination: 60 Marks		
<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test</b> <b>Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<b>Section (A)</b> - Five very short answer question (20 words each) <b>Section (B)</b> - Five short answer question (200 words each) <b>Section (C)</b> - Two long answer question (500 words each)	<b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b>

<b>Part A Introduction</b>			
<b>Program: 2 year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II Semester III</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0302-T	
<b>2</b>	<b>Course Title</b>	Plant and Animal Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>Course Objectives:</b> To create general understanding about Plant and Animal Biotechnology</p> <ol style="list-style-type: none"> <li>1. This course provides understanding of the tools and techniques of biotechnology to develop genetically engineered or genetically modified plants for agronomic purposes.</li> <li>2. Become familiar with sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis.</li> <li>3. Students will gain a basic working knowledge of concepts and techniques necessary for animal tissue culture.</li> <li>4. It will give students an overview of the latest developments in animal cell culture and various technical applications including cell line and stem cells.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

Part B Content of the Course		
Total Number of Lecture Hours – 90		
Unit	Topics	No of Lecture Hours
I	<p>Application of micropropagation techniques to conserve endangered medicinal plants mentioned in classical texts (e.g., Ashwagandha, Guduchi).</p> <p>Plant Tissue Culture: Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.</p> <p>Structure and organization of animal cell, Equipments and materials for animal cell culture technology Primary and established cell line cultures, Introduction to the balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum &amp; protein free defined media and their application.</p> <p><b>Activity:</b> Debate on the context of Gandhari's Sons who were thought to be developed by Animal cell culture techniques/ stem cell biology.</p> <p><b>Key words:</b> Artificial seed production, Micropropagation, Role of serum, Established cell line cultures.</p>	18
II	<p>Agrobiology: Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid.</p> <p>Genetic Transformation, Agrobacterium-mediated gene delivery; Co integrate and binary vectors and their utility; Direct gene transfer-PEG-mediated, electroporation, particle bombardment and alternative methods;</p>	18

	<p>Screen able and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting.</p> <p><b>Activity:</b> Conventional Indian practices of grafting and plant trait transmission.</p> <p><b>Key words:</b> Genetic Transformation, Screenable markers, Gene targeting, Transgenics.</p>	
<b>III</b>	<p>Molecular Mapping &amp; Marker Assisted Selection (MAS)</p> <p>Quantitative and qualitative traits; MAS for genes of agronomic importance, e.g. insert resistance, grain quality and grain yield; Molecular polymorphism, RFLP, RAPD, STS AFLP, SNP markers; Construction of genetic and physical map; Gene mapping and cloning; QTL mapping and cloning.</p> <p>Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance, Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.</p> <p><b>Activity:</b> Conventional crop rotation practices used by farmers to avoid biotic and abiotic stresses.</p> <p><b>Key words:</b> RAPD, AFLP, Gene mapping, Herbicide resistance, Molecular polymorphism, Fungal resistance.</p>	18
<b>IV</b>	<p>Scaling-up of animal cell culture, Cell synchronization, Cell cloning and micro manipulation, Cell transformation, organ and histotypic cultures, 3-D culture and tissue engineering, transfection of mammalian cells, applications of animal cell culture, cell culture-based vaccines.</p> <p><b>Activity:</b> Literature survey on ancient knowledge of animal cell culture in India.</p> <p><b>Key words:</b> 3-D culture, animal cell culture, cell culture-based vaccines.</p>	18

<b>V</b>	<p>Application of animal cell culture; Stem cell cultures, embryonic stem cells and their applications Cell culture, based vaccines, Somatic cell genetics, Organ and histotypic cultures, Measurement of cell death; Apoptosis .</p> <p><b>Activity:</b> Debate on ethical concerns about isolation of embryonic stem cells.</p> <p><b>Key words:</b> Stem cell cultures, Organ and histotypic cultures, Somatic cell genetics.</p>	18
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### Part C Learning Resources

#### Text Books, Reference Books, Other resources

#### **Suggested Readings –Texts/References: Plant and Animal Biotechnology**

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plant, latest Edition, Oxford University Press.
2. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.
3. Introduction to Plant Biotechnology, HS Chawla, 4th edition, 2024
4. PLANT BIOTECHNOLOGY, 4TH EDITION, BD Singh, 2022
5. Plant Biotechnology: Principles and Applications, N Mitchell, 2022
6. Ann A. Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
7. Peter J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
8. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006.
9. A.D. Ho., R. Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
10. C.S. Potten, Stem Cells, Elsevier, 2006.
11. Amanda Capes-Davis, R. Ian Freshney. Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 8th Edition. Wiley-Blackwell Publisher.
12. Shalini Mani, Manisha Singh, Anil Kumar. Animal Cell culture: Principles and Practice (Springer Publisher).

#### **Suggested digital platforms web links**

[https://sist.sathyabama.ac.in/sist\\_coursematerial/uploads/SBB2103.pdf](https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB2103.pdf)

<https://archive.nptel.ac.in/courses/102/103/102103016/>

<https://nptel.thapar.edu/biotech.html>

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<p><b>Section (A)</b>- Five very short answer question (20 words each)</p> <p><b>Section (B)</b>- Five short answer question (200 words each)</p> <p><b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i></p> <p><b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i></p> <p><b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i></p> <p><b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: 2 year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II</b> <b>Semester III</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0301-P	
<b>2</b>	<b>Course Title</b>	Lab on Bioprocess Engineering and Technology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>Course Objective :</b></p> <p>The objective of the course is to prepare students competent in subject through in-depth lecture and laboratory practices. Student will be able to:</p> <ol style="list-style-type: none"> <li>1. Student will be able to Understand Fundamentals of Bioprocess Engineering.</li> <li>2. Master Bioreactor Design and Operation</li> <li>3. Analyze Bioprocess Kinetics and Mass Transfer</li> <li>4. Apply Downstream Processing Techniques</li> <li>5. Become industry ready and competent enough to apply basic concepts in Industry</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<p><b><u>List of Practical</u></b></p> <ol style="list-style-type: none"> <li>1. Determination of oxygen transfer rate and volumetric oxygen mass transfer coefficient (KLa) under variety of operating conditions in shake flask and bioreactor.</li> <li>2. Determination of mixing time and fluid flow behavior in bioreactor under variety of operating conditions.</li> <li>3. Rheology of microbial cultures and biopolymers and determination of various rheological constants.</li> <li>4. Production of microbial products in bioreactors.</li> <li>5. Studying the kinetics of enzymatic reaction by microorganisms.</li> <li>6. Production and purification of various enzymes from microbes.</li> <li>7. Comparative studies of Ethanol production using different substrates.</li> <li>8. Microbial production and downstream processing of an enzyme, e.g. amylase.</li> <li>9. Various immobilization techniques of cells/enzymes, use of alginate for cell immobilization.</li> <li>10. Batch Growth Kinetics of bacteria</li> </ol>	<p>Total 120</p>
<b>Part C Learning Resources</b>	
<b>Text Books, Reference Books ,Other Resources</b>	
<p><b>Suggested Readings –</b></p> <ol style="list-style-type: none"> <li>1 Laboratory Techniques in Modern Biology ;N.Swarup , S.C. Pathak , S. Arora , Kalyani Publication, New delhi.</li> <li>2 Integrated Methodologies in Biology ;Shashi Shrivatava ,P. Banerjee , Arun Prakashan, Gwalior.</li> <li>3 Experiment in Microbiology Plant Pathology and Biotechnology;K.R.Anejaa, New Age International ,New Delhi, 2007.</li> <li>4 Laboratory Manual of Biotechnology ; P.N.Swamy , Rastogi Publication ,Meerut.</li> <li>5 Practical Microbiology ; R.C.Dubey , D.K.Maheshwari , S Chand &amp;Company, Delhi.</li> <li>6 Manual of Experiments in Biotechnology ;Leena Lakhani, Sheeba Khan , Kailash Pustak Sadan, Bhopal.</li> </ol> <p><b>Virtual Lab links</b>  <a href="https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering">https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering</a>  <a href="https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering">https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering</a></p>	
<p><b>Suggested equivalent online courses:</b></p>	

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

<b>Part A Introduction</b>			
<b>Program: 2 Year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II</b> <b>Semester III</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0302-P	
<b>2</b>	<b>Course Title</b>	Lab on Plant and Animal Biotechnology	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>On successful completion of the course, the students will be able to</b></p> <ol style="list-style-type: none"> <li><b>1. Learn about plant tissue culture techniques and secondary metabolites production.</b></li> <li><b>2. Learn about transgenesis and molecular markers.</b></li> <li><b>3. Learn about animal tissue culture techniques</b></li> <li><b>4. Learn about transgenic animals and gene therapy.</b></li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 40

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<p><b><u>List of Practicals</u></b></p> <ol style="list-style-type: none"> <li>1. Aseptic culture techniques for establishment and maintenance of cultures</li> <li>2. Preparation of stock solutions of MS basal medium and plant growth regulator stocks.</li> <li>3. Micropropagation of Tobacco plant by leaf disc culture.</li> <li>4. Micropropagation of Rice by indirect organogenesis from embryo</li> <li>5. Preparation of competent cells of E. coli for harvesting plant transformation vector</li> </ol>	Total 120

- |  |  |
|--|--|
| 6. Transformation of competent cells of E. coli with plant transformation vectors.<br>7. Small scale plasmid preparation from E. coli.<br>8. DNA check run by Agarose Electrophoresis<br>9. Restriction digestion of insert plasmid) and binary vector.<br>10. Primary cell culture.<br>11. Preparation of media for animal cell culture.<br>12. MTT Assay for viability.<br>13. Apoptosis study by ELISA.<br>14. Animal tissue culture – maintenance of established cell lines.<br>15. Estimation of cell viability by dye exclusion (Trypan blue). |  |
|--|--|

**Part C Learning Resources**

**Text Books, Reference Books ,Other Resources**

**Virtual Lab Links:**

<https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>  
<https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

**Suggested equivalent online courses:**

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

## IV (Fourth) semester II year PG Biotechnology

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II Semester IV</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0401-T	
<b>2</b>	<b>Course Title</b>	IPR, Bioethics and Biosafety	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	On completion of course, student will able to: CO1 - Define biosafety, bioethics and intellectual property rights. CO2 - Discuss the different regulations pertaining to biosafety. CO3 - Categorize the various forms of IPR. CO4 - Compile different attributes of intellectual property rights and their implications in biological research and product development CO5 - Appraise the importance of bioethics in biotechnology. CO6 - Defend and modify ethical aspects related to biological, biomedical, health care and biotechnology research.	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

<b>Part B Content of the Course</b>		
<b>Total Number of Lecture Hours – 90</b>		
<b>Unit</b>	<b>Topics</b>	<b>No of Lecture Hours</b>
<b>I</b>	<p>Introduction to Intellectual Property</p> <p>IKS: Ethics as a common practice in every aspects of life in ancient India.</p> <p>Types of IP: Patents, Trademarks, Copyright &amp; Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP, IP as a factor in R&amp;D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of WIPO and TRIPS.</p> <p><b>Activity:</b> Assignments on the Pros and Cons of Genetically modified organisms.</p> <p><b>Key words:</b> IPR, GMO, Biotechnology</p>	15
<b>II</b>	<p>Concept of ‘prior art’: invention in context of “prior art”; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation</p> <p>Basics of Patents</p> <p>Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; patent Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Country Patent Office; Procedure for filing a PCT application</p> <p><b>Activity:</b> Assignments on the writing of Patent publication.</p> <p><b>Key words:</b> prior art, patent, Indian patent Act, Treaties</p>	15
<b>III</b>	<p>Patent filing and Infringement Implications; Role of a Patent application-forms and guidelines, fee structure, time frames; Types of patent applications: and complete specifications; PCT and convention patent applications; International provisional patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to patents-gazette of India, status in Europe and US existing schemes; Publication of</p> <p>Patenting by research students, lecturers and scientists-university/organizational rules in India and sharing by workers, financial</p>	15

	<p>incentives Patent infringement- meaning, scope, litigation, abroad, credit case studies and examples.</p> <p><b>Activity:</b> Assignment on international patent guidelines and requirements.</p> <p><b>Key words:</b>Patent, application, types, patent infringement</p>	
IV	<p>Biosafety</p> <p>Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs &amp; LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.</p> <p><b>Activity:</b> Assignment on the importance of the biosafety guidelines during handling of infectious agents and genetic engineering based experimentation.</p> <p><b>Key words:</b>Biosafety levels, biosafety guidelines, Risk analysis and Management</p>	15
V	<p>Bioethics</p> <p>Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy.</p> <p><b>Activity: Assignments on the bioethics in prenatal diagnosis and associated laws.</b></p> <p><b>Key Words:</b>ethical conflicts, research, publications, agriculture, environmental risk</p>	15

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### Suggested Readings –

1. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
2. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
3. Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell.
4. Goel and Parashar, IPR, Bioethics and Biosafety, Pearson
5. Karen F. Greif and Jon F. Merz, Current Controversies in the Biological Sciences -Case Studies of Policy Challenges from New Technologies, MIT Press
6. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of. India.

#### Suggested digital platforms web links

##### Important Links

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

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

[http://www.ipr.co.uk/IP\\_conventions/patent\\_cooperation\\_treaty.html](http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html)

[www.patentoffice.nic.in](http://www.patentoffice.nic.in)

<http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods:- (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)-</b> Five very short answer question (20 words each) <b>Section (B)-</b> Five short answer question (200 words each) <b>Section (C)-</b> Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II Year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II Semester IV</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0402-T	
<b>2</b>	<b>Course Title</b>	Regenerative Biotechnology & Cancer Genetics	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc.	
<b>5</b>	<b>Course Learning Outcomes</b>	<p><b>Course Objectives:</b> Objectives of this course are: this course:</p> <p>CO1- to familiarize the students with stem cell technology and its applications for betterment of the society.</p> <p>CO2-student will have a broad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured.</p> <p>CO3: Student will know about the basic biology of these stem cells as well as bioengineering and application of these stem cells to potential treatments of human diseases.</p> <p>CO4- To advance knowledge about organism develops from a single cell and how healthy cells replace damaged cells in adult organisms.</p>	
<b>6</b>	<b>Credit Value</b>	6	
<b>7</b>	<b>Total Marks</b>	Max.Marks 100 (University exam 60, Internal CCE 40)	Min. Marks 40

<b>Part B Content of the Course</b>		
<b>Total Number of Lecture Hours – 90</b>		
<b>Unit</b>	<b>Topics</b>	<b>No of Lecture Hours</b>
<b>I</b>	<p><b>EMBRYONIC AND ADULT STEM CELLS</b></p> <p><b>IKS:</b> Discussion on the examples of regenerative medicine and tissue engineering during ancient India in mythological literature.</p> <p>Stem cell differentiation; stem cells cryopreservation. Somatic stem cells, Test for identification of adult stem cells, Adult stem cell differentiation - Trans differentiation -Plasticity - Different types of adult stem cells- Isolation of haemopoietic stem cell, Muscle and Cardiac stem cell and their applications.</p> <p><b>Activity:</b> Isolation of the cells from tissue and their preservation.</p> <p><b>Key words:</b> Embryonic stem cells, adult stem cells, stem cell. differentiation, stem cell identification</p>	18
<b>II</b>	<p><b>ADVANCEMENT OF STEM CELL IN TISSUE ENGINEERING</b></p> <p>Tissue engineering triad, ECM components and their role in tissue development, Tissue engineering application - Production of complete organ - Kidney - Eyes - Heart - Brain.</p> <p><b>Activity:</b> Assignments on the various methods of tissue engineering.</p> <p><b>Key words:</b>Tissue engineering, ECM components, applications</p>	18
<b>III</b>	<p><b>THERAPEUTIC APPLICATION OF STEM CELLS</b></p> <p>Gene therapy - genetically engineered stem cells - stem cells and Animal cloning - transgenic animals and stem cells - Therapeutic applications – Parkinson’s disease - Neurological disorder - limb amputation - heart disease - spinal cord injuries - diabetes -burns - HLA typing- Alzheimer’s disease.</p> <p><b>Activity:</b> Assignments on the methodology of in vitro fertilization and animal cloning.</p> <p><b>Key Words:</b>Gene therapy, transgenic animals, therapeutic applications</p>	18
<b>IV</b>	<p><b>CANCER GENETICS</b></p> <p><b>Cell Transformation and tumorigenesis:</b></p>	18

	<p>Oncogenes; Tumour Suppressor genes; DNA repair genes and genetic instability; Epigenetic modifications, telomerase activity, centrosome malfunction; Genetic heterogeneity and clonal evolution,</p> <p>Familial Cancers: Retinoblastoma, Wilm’s Tumour, Li-Fraumeni syndrome, colorectal cancer, breast cancer, Genetic sporadic cancer</p> <p><b>Activity:</b> Assignments on the pathways involved in genetic instability and cancer cell transformation.</p> <p><b>Key words:</b> Oncogenes, tumour suppressors, Familial cancer, sporadic cancer</p>	
V	<p><b>Tumour progression:</b></p> <p>Angiogenesis and metastasis; Tumour specific markers</p> <p>Cancer and environment: physical, chemical and biological carcinogenesis; Cancer risk assessment, gene therapy and counselling</p> <p><b>Activity:</b> Assignments on the invasion-metastasis cascade and cancer recurrence.</p> <p><b>Key words:</b> Metastasis, tumour specific markers, cancer risk assessment, counselling</p>	18

## Part C Learning Resources

### Text Books, Reference Books, Other resources

#### Suggested Readings –

1. Kursad and Turksen, Embryonic Stem cells, Humana Press, 2002
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research,12 National Academic press, 2002.

#### Suggested digital platforms web links

<https://innovatebio.org/article/teaching-stem-cell-biology-syllabus-and-learning-guide>  
[n.cross@shu.ac.uk](mailto:n.cross@shu.ac.uk)

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods:- (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks</p> <p>20 Marks</p> <p><b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)-</b> Five very short answer question (20 words each)</p> <p><b>Section (B)-</b> Five short answer question (200 words each)</p> <p><b>Section (C)-</b> Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i></p> <p><b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i></p> <p><b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i></p> <p><b>Total Marks = 60</b></p>

<b>Part A Introduction</b>			
<b>Program: II year PG</b>	<b>Class: M.Sc.</b>	<b>Year: II</b> <b>Semester IV</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0401-P	
<b>2</b>	<b>Course Title</b>	IPR, Biosafety and Bioethics	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	The overall course outcome is that the student shall develop deeper understanding of IPR, Biosafety and Bioethics 1.	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 33

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<b><u>List of Practicals</u></b>	Total 120
1. Learning about Patent application processes 2. Risk assessment of genetically modified organisms (GMOs), and ethical considerations in research involving humans and animals. 3. Specific examples include analyzing case studies on biopiracy, practicing good laboratory biosafety practices, and evaluating the ethical implications of gene therapy.	

## Part C Learning Resources

### Text Books, Reference Books ,Other Resources

#### Reference books:

1. Simy Joy ,Payal Anand ,Priya Nair Rajeev. IPR, Biosafety and Bioethics. ISBN 9788131774700 (**Imprint** Pearson Education).
2. Goel And Parashar. IPR, Biosafety and Bioethics (Pearson).

#### Virtual lab links:

1. [https://www.youtube.com/results?search\\_query=Intellectual+property+rights](https://www.youtube.com/results?search_query=Intellectual+property+rights)
2. [https://www.youtube.com/results?search\\_query=biosafety](https://www.youtube.com/results?search_query=biosafety)
3. [https://www.youtube.com/results?search\\_query=bioethics](https://www.youtube.com/results?search_query=bioethics)

#### Suggested equivalent online courses :

## Part-D Assessment and Evaluation

### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

<b>Part A Introduction</b>			
<b>Program: PG II year</b>	<b>Class: M.Sc.</b>	<b>Year: II</b> <b>Semester IV</b>	<b>Session: 2025-26</b>
<b>Subject: Biotechnology</b>			
<b>1</b>	<b>Course Code</b>	MBTC0402-P	
<b>2</b>	<b>Course Title</b>	Lab on Regenerative Biotechnology & Cancer Genetics	
<b>3</b>	<b>Course Type</b>	Core Course	
<b>4</b>	<b>Prerequisite</b>	To study this course a student must have Biotechnology or Allied subjects in B.Sc	
<b>5</b>	<b>Course Learning Outcomes</b>	<p>The course aim to:</p> <ol style="list-style-type: none"> <li>1. understanding the differences between germ cell types;</li> <li>2. understanding the transcriptional networks and epigenetic factors that regulate pluripotency</li> <li>3. status and cellular reprogramming;</li> <li>4. familiarity with recent applications of stem cells in clinical studies of Regenerative Medicine.</li> </ol>	
<b>6</b>	<b>Credit Value</b>	4	
<b>7</b>	<b>Total Marks</b>	Max Mark 100	Min Marks 33

<b>Part B Content of Course</b>	
<b>Total No of Practical (In Hours): 120</b>	
Topics	Hours.
<p><b><u>List of Practicals:</u></b></p> <ol style="list-style-type: none"> <li>1. MTT Assay for cell proliferation/cytotoxicity</li> <li>2. Cell culture techniques, passaging and maintenance of human cancer cell line</li> <li>3. Media preparation and counting of cells</li> <li>4. Cryopreservation: Freezing &amp; thawing of human cancer cell line</li> <li>5. Genomic DNA isolation from cancer cell line</li> <li>6. Bioinformatics tools for the above techniques: DNA databases</li> <li>7. Sequence Analysis: Pairwise sequence alignment, Multiple sequence alignment, BLAST tools</li> </ol>	Total 120

## Part C Learning Resources

### Text Books, Reference Books ,Other Resources

#### Suggested Readings –

1. <https://www.ncbi.nlm.nih.gov/books/NBK27044/>

**StemBook Cambridge (MA): Harvard Stem Cell Institute; 2008-.ISSN: 1940-3429.**

2. <https://www.ncbi.nlm.nih.gov/books/?term=Stem+cell+biology>

3. R. Ian Freshney, Amanda Capes-Davis. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (Hardcover – 2021).

4. Fred Bunz. Principles of Cancer Genetics. <https://doi.org/10.1007/978-3-030-99387-0>

5. Robin Hesketh. Introduction to Cancer Biology-A Concise Journey from Epidemiology through Cell and Molecular Biology to Treatment and Prospects (University of Cambridge).

#### Virtual Lab Links:

1. [https://www.youtube.com/shorts/7L\\_FZ2OZmK0](https://www.youtube.com/shorts/7L_FZ2OZmK0)
2. [https://www.youtube.com/results?search\\_query=Stem+cell+biology+techniques](https://www.youtube.com/results?search_query=Stem+cell+biology+techniques)
3. [https://www.youtube.com/results?search\\_query=transwell+migration](https://www.youtube.com/results?search_query=transwell+migration)
4. [https://www.youtube.com/results?search\\_query=scratch+assay](https://www.youtube.com/results?search_query=scratch+assay)
5. [https://www.youtube.com/results?search\\_query=MTT+assay](https://www.youtube.com/results?search_query=MTT+assay)
6. [https://www.youtube.com/results?search\\_query=spheroid+cell+culture](https://www.youtube.com/results?search_query=spheroid+cell+culture)
7. [https://www.youtube.com/results?search\\_query=cell+culture+on+ultra+adherent+plate](https://www.youtube.com/results?search_query=cell+culture+on+ultra+adherent+plate)

#### Suggested equivalent online courses :

### Part-D Assessment and Evaluation

#### Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>