CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

Syllabus of the Examination for
Post Graduate Programme
In

M.Sc. Biotechnology

(As Per NEP-2020)
Curriculum and Credit Framework for Post Graduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the Session 2025-2026 (In Phased Manner)

Faculty of Life Sciences
Department of Biotechnology
Chaudhary Ranbir Singh University, Jind

Scheme of the Examination for Post Graduate Programme in M.Sc. Biotechnology

(As Per NEP-2020 Curriculum and Credit Framework for Post Graduate Programme)
With Multiple Entry-Exit, Internship and CBCS-LOCF with effect from the Session 2025-2026 (In Phased Manner)

Sem.	Course Type	Course Code	Nomenclature of course	Theory (T)/ Practical (P)	Credits		Contact hours per week (L:Lecture; P: Practical; T:Tutorial)				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination Hours
						Total	L	T	P	Total				
1	CC-1	M24-BTY-101	Biomolecules	T	4	26	4	0	0	4	30	70	100	3
	CC-2	M24-BTY-102	Molecular Cell Biology	T	4		4	0	0	4	30	70	100	3
	CC-3	M24-BTY-103	Microbiology & Biotechniques	T	4		4	0	0	4	30	70	100	3
	CC-4	M24-BTY-104	Enzyme Technology	T	4		4	0	0	4	30	70	100	3
	PC-1	M24-BTY-105	Bio-molecules & Enzyme Technology (Lab)	P	4		0	0	8	8	30	70	100	4
	PC-2	M24-BTY-106	Molecular Cell Biology; Microbiology & Biotechniques (Lab)	P	4		0	0	8	8	30	70	100	4
	Seminar	M24-BTY-107	Seminar	S	2		0	0	0	2	0	50	50	1
2	CC-5	M24-BTY-201	Genetic Engineering	T	4	26	4	0	0	4	30	70	100	3
	CC-6	M24-BTY-202	Animal Cell & Tissue Culture	T	4		4	0	0	4	30	70	100	3
	CC-7	M24-BTY-203	Plant Cell &Tissue Culture	T	4		4	0	0	4	30	70	100	3
	CC-8	M24-BTY-204	Bioinformatics	T	4		4	0	0	4	30	70	100	3
	PC-3	M24-BTY-205	Animal and Plant Cell & Tissue Culture Technology (Lab)	P	4		0	0	8	8	30	70	100	4
	PC-4	M24-BTY-206	Genetic Engineering & Bioinformatics (Lab)	P	4		0	0	8	8	30	70	100	4
	CHM	M24-CHM-201	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
	Internship	M24-INT-200	**Internship***								50	50	100	

**An internship course of 4 Credits of 4-6 weeks duration during summer vacation after 2nd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.*

3	CC-9	M24-BTY-301	Plant Biotechnology	T	4	26	4	0	0	4	30	70	100	3
	CC-10	M24-BTY-302	Microbial Biotechnology	T	4		4	0	0	4	30	70	100	3
	DEC-1	M24-BTY-303	Molecular Genetics	T	4		4	0	0	4	30	70	100	3
	DEC-2	M24-BTY-305	Immunology	T	4		4	0	0	4	30	70	100	3
	Any one	M24-BTY-306	Molecular Medicine & Diagnostic Techniques	T	4		4	0	0	4	30	70	100	3
	PC-5	M24-BTY-307	Plant & Microbial Biotechnology (Lab)	P	4		0	0	8	8	30	70	100	4
	PC-6	M24-BTY-308	Molecular Genetics, Immunology/Molecular Medicine & Diagnostic Techniques (Lab)	P	4		0	0	8	8	30	70	100	4
	OEC	M24-OEC-303	Biotechnology & Human Welfare	T	2		2	0	0	2	15	35	50	3
4	CC-11	M24-BTY-401	Animal & Medical Biotechnology	T	4	26	4	0	0	4	30	70	100	3
	CC-12	M24-BTY-402	Environmental Biotechnology	T	4		4	0	0	4	30	70	100	3
	DEC-3	M24-BTY-403	Food Biotechnology	T	4		4	0	0	4	30	70	100	3
	DEC-4	M24-BTY-405	Genomics, Proteomics & Metabolomics	T	4		4	0	0	4	30	70	100	3
	Any one	M24-BTY-406	Biosafety, Bioethics & IPR Issues of Biotechnology	T	4		4	0	0	4	30	70	100	3
	PC-7	M24-BTY-407	Food & Environmental Biotechnology (Lab)	P	4		0	0	8	8	30	70	100	4
	PC-8	M24-BTY-408	Animal & Medical Biotechnology; Biosafety, Bioethics & IPR Isuues of Biotechnology/Genomics, Proteomics & Metabolomics (Lab)	P	4		0	0	8	8	30	70	100	4
	EEC	M24-BTY-409	Entrepreneurship & Diagnostic Techniques	T	2		2	0	0	2	15	35	50	3
	OR DISSERTATION (**Note:** If a Candidate is Offered Dissertation Course, Then He/She will also Study CC-11, DEC-3, DEC-4 & EEC from Above Courses of Semester-4)													
	Dissertation/ Project Work	**M24-BTY-410**	**Dissertation/Project Work**	D	12	26	0	0	0	-	0	300	300	-
	TOTAL CREDITS					**104**	**TOTAL MARKS**						**2700**	

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Curriculum and Credit Framework for Post Graduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the Session 2024-2025 (In Phased Manner)

Faculty of Life Sciences
Department of Biotechnology
Chaudhary Ranbir Singh University, Jind

Chaudhary Ranbir Singh University, Jind

Syllabus for M.Sc. Biotechnology (CBCS) **(III-Semester)**

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Plant Biotechnology**		
Course Code	**M24-BTY-301**		
Course Type	**CC-9**		
Level of course (**Anx-1**)	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Acquire Recent Knowledge & Learn Techniques related to organization of Plant Genome, Vectors, Methods of Genetic Transformation and other aspects that are important for raising and Molecular analysis of Transgenics. Understand the Gene Silencing & Stacking. **CLO-2:** Understand Genetic Engineering strategies for quality improvement and other value added Transgenic. They would be able to launch start-ups and become entrepreneurs for various products and processes related to plant biotechnology. **CLO-3:** Attain knowledge for strategies of high yielding of plant bioactive/therapeutic Biomolecules of industrial importance. Have an overview of different cell culture systems, bioreactors for them and technologies for extraction and isolation of secondary metabolites. **CLO-4:** Understand IPR, Biosafety & ethical issues related to GM crops.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Plant Genetic Transformation:** Organization of Plant, Nuclear, Chloroplast and Mitochondrial Genomes, Gene Tagging. **Chloroplast Transformation:** Vector Designing, Method and Advantages. *Agrobacterium* mediated transformation-Ti and Ri Plasmids, Role of Virulence Genes, Mechanism of T-DNA transfer, Vectors based on Ti and Ri plasmids-Cointegrate and Binary vectors, technique and factors affecting *Agrobacterium* mediated transformation of plants. **Direct Gene Transfer:** Particle Bombardment, ArF excimer laser, Electroporation, Microinjection and alternative methods. Screenable and Selectable markers.	20

	Analysis of Transgenic Plants: For the presence, integration and expression of transgenes and by biological assays. Gene Silencing in Transgenic Plants. **Gene Stacking in Plants:** Methods, advantages and drawbacks of each method.	
II	**Introducing Strategies of Biotic and Abiotic Stress Resistance/Tolerance:** Viral, Fungal, Insect, Herbicide resistance, Various Abiotic stresses (like Drought, Salinity, Ttemperature). **Genetic Engineering of Plants for Molecular Farming/Pharming:** Production of Antibodies, Vaccines and other Medically related Proteins in Plants. Nutritional Enhancement of Plants (Carbohydrates, Seed storage Proteins, Vitamins), Manipulation of Flower color and Production of Enzymes of Industrial Importance.	16
III	**Plant Cells as Biofactories for Production of Secondary Metabolites:** Secondary Metabolites, Types of Cell Culture Systems used for Production of Secondary Metabolites and Advantages of their *in-vitro* production. **Strategies used for High Yield of Product:** Development and Selection of High Yielding Cell-line Cultures, Optimization of Factors affecting Yield of Plant Cells (Physical Culture Conditions, Media and other Bio-chemicals), Immobilization of Plant Cells, Bioreactors for Plant Cell, Organ & Immobilized Plant Cell Cultures, Bio-transformation, Permeabilization of Cells and Removal of Secreted Products.	14
IV	**Intellectual Property Rights, Bio-safety & Ethical Issues:** Intellectual Property Right (IPR): Patents, Trade Secrets, Copyright, Geographical Indications, Trademarks; GATT & TRIPPS; Patenting of Biological Material; Plant Breeders Rights (PBRs) & Farmers Rights; Clean Gene Technology; Current Status of Transgenic Crops; Bane & Boon of GM Crops; Concerns about GM Crops-Environmental, Bio-safety & Ethical Issues.	10
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30			**End Term Examination: 70**	
Theory		**30**	**Theory**	**70**
❖ Class Participation		05	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*		10		
❖ Mid-Term Exam		15		

Part C-*Learning Resources*

Recommended Books:

1. ***Elements of Biotechnology***. PK Gupta, 4th Reprint (2nd Edition): 2019-2020, Rastogi Pub.
2. ***Plant Genetic Engineering***. Vol: 1-6 (2003). Singh & Jaiwal (Eds.), Sci Tech. Publishing LLC, USA.
3. ***Introduction to Biotechnology***. HS Chawla (2009), 3rd Ed., Science Pub.
4. ***Plant Tissue Culture: Theory & Practice.*** Bhojwani SS & Razdan M K (2005). Elsevier Publication.
5. ***Plant Biotechnology.*** Hammond J, Mc Garvey P & Yusibov V (2000) (Eds.) Springer Verlag, Germany.
6. ***Practical Application of Plant Molecular Biology.*** Henry RJC & Hall (1997).
7. ***Plants, Genes & Agriculture***. Chrispeels MJ & Sadava DE (2002). 2nd Ed. Jones & Bartlett Pub. UK.
8. ***Plant Biotechnology***. The Genetic Manipulation of Plants (2nd Edition). Slater A, Scott N & Fowler M, Oxford Pub. (2008).
9. ***Crop Biotechnology: Genetic Modification and Genome Editing.*** Nigel G Halford (2018). World Scientific Pub. Europe Ltd. UK.
10. ***Plant Biotechnology: Principles & and Applications***. Malik ZA, Usha K, Kamaluddin & Athar A (2017). Springer Nature, Singapore.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Microbial Biotechnology**		
Course Code	**M24-BTY-302**		
Course Type	**CC-10**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Evaluate the role of Micro-organisms in Specific Biotechnological processes. Have insight about Industrially important Microbes, Recent Developments in Fermentation Processes & various types of Fermentations. **CLO-2:** Attain knowledge about Designing of Industrial Strains & various Media Optimization strategies, Strategies for overproduction of Industrial important Metabolites structure and functioning of fermenter. **CLO-3:** Get introduced to various strategies of product recovery from a Fermentation Broth. **CLO-4.** Understand the basic principles of microbial commercial fermentations, knowledge to solve critical problems.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Microbial Biotechnology:** Scopes, Application & Challenges. **Biology of Industrial Microorganisms:** Industrial Microorganisms, Growth Metabolism Regulation, Substrate Assimilation/Product Formation. Isolation & Preservation of Industrially Important Microorganisms. **Fermentation System:** Batch, Fed Batch and Continuous System, Multistage System. Solid State Fermentation & its Applications.	15
II	**Overproduction of Primary & Secondary Metabolites:** Use of Mutation Selection & Recombination Techniques. **Fermentation Raw Materials:** Media for Industrial Fermentations, Criteria used in Media Formulation. **Fermenter/Bioreactor Design & Operation:** Types of Fermenters, Stirred Tank Reactor, Bubble Column Reactor, Airlift Reactor, Packed Bed Reactor, Fluidized Bed Reactor & Trickle Bed Reactor, Agitation & Aeration in a Reactor, Mass Transfer, Foam Formation & Control.	15

III	Industrial Production of Alcoholic Beverages (Whisky, Wine & Beer) and Improvement by Genetic Engineering. **Microbial Production of Food Additives:** Amino-acids, Nucleosides & Vitamins. **Microbial Production of Industrial Chemicals:** Bulk Organic-chemicals, Ethanol, Citric-acid, Acetic-acid, Gluconic-acid, Glycerol, Acetone & Butanol. **Microbial Production of Healthcare Products:** Antibiotics (Penicillin & Tetracyclines), Vaccines (Bacterial cells & Toxins).	15
IV	**Microbial Inoculants:** Food Starter Cultures; Baker's Yeast, Starter Cultures for Dairy Industry, Meat Starter Cultures. **Biomass Production:** Single Cell Protein (SCP) Production; Microbial Inoculants; Microbial Transformation of Steroids & Sterols. **Down-stream Processing:** Separation processes for Microbial Cells and other Solids, Cell disruption, Centrifugation, Solvent recovery, Drying and Crystallization. Recovery schemes for Non-volatile Metabolites, Biomass, Extra-cellulars Polysaccharides & Enzymes.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory**	**70**
❖ Class Participation	05	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Principles of Fermentation Technology***. Stansbury PF *et al.* (1997). Pergmon Press, Oxford.

2. ***Fermentation Biotechnology: Principles, Process & Products.*** Ward OP (1998). Prentice Hall Publishing, New Jersey.

3. ***Microbial Biotechnology: Basic Research & Applications.*** Singh *et al.* (2020). Pub. Springer. (Ed.).

4. ***Modern Industrial Microbiology and Biotechnology***. Nduka Okafor (2007). Science Publishers

5. ***Manual of Industrial Microbiology & Biotechnology***. Arnold I Demain & Julian E Davies (1999). 2nd Edition, ASM Press, Washington DC.

6. ***Microbial Biotechnology***. Glazer & Nikaido (1998). WH Freeman & Company, New York.

7. ***Biotechnology: A Textbook of Industrial Microbiology***. Cruger & Cruger (2002), 2nd Edition, Panima Pub. Corporation, New Delhi.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Molecular Genetics**		
Course Code	**M24-BTY-303**		
Course Type	**DEC-1**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Acquire the knowledge of Genome structure & organization in eukaryotes, DNA mutability, genotoxicity assays, transcription regulation in prokaryotes and eukaryotes, site specific recombination and its applications in genome manipulation. **CLO-2:** Learn advanced techniques of Genome Mapping & Sequencing, comparative Genomics and Transcriptome analysis. **CLO-3:** Know fundamentals and applications of Metabolic Engineering. **CLO-4:** Get acquainted with Methodological concepts and tools needed to acquire top level skills in the field of Molecular Genetics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Eukaryotic Genome Structure & Organization:** Genome Sequence & Chromosome Diversity, Variation in Chromosome Number, Special features of Metaphase Chromosomes, Chromosome Banding, Genome Size & Complexity, Organization & Content of Human Genome, Repetitive DNA, Microsatellites, Genome Wide Repeats, Split Genes, Overlapping Genes, Cryptic Genes, Retro-Genes, Multi-Gene Families, Pseudo-Genes. **Nucleosome:** Basic Structure, Spatial arrangements of Histones, Chromatosome, Solenoid Model, Chromatin domains & Modifications. **Mutability of DNA:** An overview of Mutation and Polymorphism, VNTR Polymorphism, DNA damage-Spontaneous, Induced (Alkylation, Oxidation, Radiation), Genotoxicity/Mutagenicity test systems-Ames test, Sister Chromatid exchanges, Micronucleus, Comet assay.	15
II	**Transcription Regulation in Prokaryotes:** Positive & Negative Control of Transcription, Repression & Activation, Organization & Regulation of *Lac*, *Trp* & *Ara* Operon in *E. coli*, Organization of Genome in Lambda phage	18

	(Early, Middle & Late Genes), Regulation of Lytic cascade, Anti-termination, Repressor proteins (c1,c11,c111,cro), Establishment of Lysogeny, Cooperative binding of Repressor, Maintenance of Autogenous circuit by c1 repressor. **Transcription Regulation in Eukaryotes:** Eukaryotic activators, DNA binding domains, Transcriptional repressors, positive & negative regulation of Yeast Galactose utilizing genes. Signal Transduction and control of transcriptional regulators, Gene Silencing, Epigenetic Gene regulation.	
III	**Regulatory RNAs:** Ribo-switches, Interfering RNA (RNAi) and gene expression, Short interfering RNA (siRNA) and its functions, Micro RNA and its functions, Antisense RNA and Gene expression, An overview of CRISPER-Cas9 gene editing technology. **Site-Specific Recombination:** Concept, Recombinases and their function, cre-lox recombination, Biological role and applications of site-specific recombination in genome manipulation. **Genome Mapping:** DNA markers for genetic mapping, RFLP, SSP, SNPs, Physical Mapping, Restriction mapping, Florescent *in-situ* hybridization (FISH), Sequence tagged sites (STS) mapping.	15
IV	**Genome Sequencing:** Types-Whole genome sequencing, Whole exome sequencing, targeted sequencing, metagenomic sequencing; Clone by clone approach or map-based sequencing, shot gun sequencing; Technologies for genome sequencing-1st Generation Sequencing methods (Sanger sequencing, Pyro-sequencing), Next generation sequencing- High throughput sequencing; Applications of genome sequencing. **Comparative Genomics:** Concept, Orthologs and paralogs, exon shuffling, Horizontal gene transfer, Genome similarity, Comparative Genomics in prokaryotes and eukaryotes, Genomic synteny, phylogenetic foot-printing **Functional Genomics:** Expression profiling, Transcriptome, DNA Arrays, Gene function determination (Gene knockout strategy, Insertional mutagenesis) **Metabolic Engineering:** Principle and methods of metabolic engineering; Directed production of molecules, production of novel compounds, Case studies on rerouting of metabolic pathways; Applications of metabolic engineering.	12
	Total Contact Hours	60

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Theory	**30**	**Theory**	**70**
	❖ Class Participation	05	Written examination	
	❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Essential Genes***. Benjamin Lewin (2007). Pearson Edu. International.

2. ***Genomes***. TA Brown (2017). Garland Science, Taylor & Francis, NY.

3. ***Principles of Gene Manipulation & Genomics.*** Primrose & Twyman (2006). Blackwell Publishing.

4. ***Molecular Biotechnology.*** Bernard and Pasternak (2017). 5th Edi. ASM press, Washington.

5. ***Human Molecular Genetics***. Tom Strachan & Andrew P Read (2011), 4th Edi. Garland Science.

6. ***Molecular Biology of Gene***. Watson Baker *et al.* (2007). Levine & Losick, Pearson Education Inc.

7. ***Principles of Genetics.*** Gardener *et al.* (2006). 8th Edi. John Wiley, NY.

8. ***Genes XII***. Lewin B (2017). 12th Edi. Jones and Bartlett Publishers.

9. ***Principles of Genetics***. Snustad and Simmons (2006), 8th Edi. Wiley

10. ***Analysis of Genes and Genomes***. Daniel and Bruce (2017). Cochrane, Jones and Bartlett Publishers.

11. ***Biotechnology and Genomics.*** Gupta PK (2013). 1st Edi. Rastogi Publishers.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Immunology**		
Course Code	**M24-BTY-305**		
Course Type	**DEC-2**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Conceptualize How Innate and Adaptive immune responses coordinate to fight invading pathogens. **CLO-2:** Understand and describe antigen, antibodies interactions, and generation of immune cells responses, and hybridoma technology for the production of monoclonal antibodies, recombinant antibodies, and different types of vaccines. **CLO-3:** Know about problems emerging in health sector and how to solve them with the knowledge of this subject. **CLO-4:** Learn about different diagnostic and therapeutic techniques in treatment of diseases.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	***Introduction and Overview:*** Introduction and overview of Immunology, Cells of Immune System, Innate & Cellular Immunity, Physical & Chemical barriers, Cellular defences, Inflammation, Receptors involved in Innate Immune System, Cells and Organs Involved in Adaptive Immune Response, Fate of Antigen after Penetration, Interrelationship between Innate & Acquired Immunity.	15
II	**Antigens, Antibodies & their interactions:** Requirements of Immunogenicity, Primary and Secondary responses, Major Classes of Antigens, Basic Structure of Antibodies, Antibody Classes and Biological Activity, Antigenic determinants on Immunoglobulins (Ig), Ig Super Family, Organization and expression of Ig Genes. **Antigen-Antibody Interactions:** Immunoprecipitation, Agglutination, ELISA, Immunofluorescence, Flow Cytometry.	15

III	**Generation of B-cell & T-cell Responses:** Complement system & its activation, Structure & role of Major Histocompatibility Complex, T-cell receptor-structure, Complex & Accessory membrane molecules, Thymic Selection of T-cells, T-cell activation & differentiation, B-cell maturation, activation & proliferation, Humoralresponse, Cytokines properties & receptors.	15
IV	**Immune System in Health and Disease:** Hypersensitivity reactions & their types and mechanism, Cancer and Immune System, Cancer Immunotherapy. **Hybridoma Technology:** Commercial production of antibodies using monoclonal antibodies. **Vaccines:** Live attenuated, killed, subunit, conjugate and DNA vaccines. Production of recombinant antibodies and edible vaccines, development of diagnostics using biotech and nanotech tools.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory**	**70**
❖ Class Participation	05	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Immunology:*** A short course. Benjamin E. 4th Edi. John Wiley, New York.
2. ***Immunology.*** Kuby J (8th Edi.). WH Freeman & Co. New York
3. ***Essential Immunology***. Roitt IM (12th Edi.). Oxford Black Well Science, London
4. ***Immunology: An introduction***. Tizardd IR (9th Edi.). Philadelphia Saunders College press.
5. ***Biotechnology and Genomics***. Gupta PK. Rastogi Publications Meerut, India
6. ***Fundamentals of Microbiology***. Jeffery C Pommerville *et al.* (2013). Jones and Bartcett Publishers.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Molecular Medicine & Diagnostic Techniques**		
Course Code	**M24-BTY-306**		
Course Type	**DEC-2**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Gain thorough understanding of various chromosomal, gene and mitochondrial disorders, different approaches to detect these disorders. **CLO-2:** Get insight into molecular basis of metabolic disorders and role of gene therapy and recombinant molecules as a potential tool in medicine, role of free radicals and metal ions in medicine. **CLO-3:** Have a broad understanding of the biomedical research for biotechnological applications. They would gain insight in to clinical aspects of Biotechnology. **CLO-4:** Get a springboard to develop their creative thinking and explore their ideas of Molecular Medicine and Diagnostics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	**Topics**	**Contact Hours**
I	**Chromosomes Anomalies and Disorders**: Numerical (Polyploidy, Aneuploidy, Autosomal, Sex-chromosomal) & Structural (Deletion, Duplication, Translocation, Inversion, Iso-chromosome, Ring-chromosome). **Single Gene Disorders**: Sickle Cell Anaemia, Haemophilia, Cystic Fibrosis, Tay-Sachs disease. **Huntington disease:** Genetics, Prevalence, Diagnosis and Prognosis, **Polygenic disorders:** Type-1 Diabetes, Breast Cancer. **Alzheimer disease**: Genetics, Prevalence, Diagnosis and Prognosis. **Mitochondrial disorders**: Mitochondrial Homeostasis and Parkinson disease.	15
II	**Immunological Approaches:** To detect protein biomarkers of disease by ELISA, Sandwich ELISA for measuring disease associated proteins, diagnosing Autoimmune diseases by indirect ELISA, Immunoassays for Infectious disease, Protein arrays to detect Polygenic disorder.	15

	DNA based approaches to disease diagnosis: Hybridization probes, allele specific hybridization, Oligonucleotide ligation assay, Padlock probes, Allele specific PCR, Real-time PCR to detect infectious disease, Detection of multiple disease associated mutations using Microarrays.	
III	**Introduction to Metabolic disorders and Profiling**, Cardiovascular diseases. Disorders in Hormonal Action. Insulin dependent and independent diabetes. Ligand induced signalling and gene expression in eukaryotic cells. Importance of Intracellular Trafficking and its related pathogenesis. **Gene therapy**: As a potential tool to cure human diseases. Molecular endocrinology in health and disease. Cancer and cell cycle, Recombinant molecules in medicine.	15
IV	**Free Radicals and Metal ions in Medicine:** Mechanisms of lipid, protein and DNA oxidation, Antioxidants-small molecules and enzymes, Reactive Oxygen Intermediates (ROI), Transition metals in oxidative processes, Involvement of oxidative processes in ageing, cancer and atherosclerosis, **Metal Ions in Gene Regulation**: Iron in human diseases-anaemia, and thalassemia, Metals and free radicals in Alzheimer's disease and other neurodegenerative diseases (NDDs).	15
	Total Contact Hours	60

Suggested Evaluation Methods

	Internal Assessment: 30		**End Term Examination: 70**	
	Theory	**30**	**Theory**	**70**
	❖ Class Participation	05	Written examination	
	❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Medical Biotechnology***. Glick BR, Delovitch TL and Patten CL (2014). ASM press.
2. ***Molecular Diagnosis of Genetic Diseases.*** Rob Elles (2003). (2nd Edi), Humana Press (2003).
3. ***Introduction to Molecular Medicine***. Dennis Ross (2002). (3rd Edi.), Springer.
4. ***Molecular Medicine:*** Genomics to Personalized Healthcare. Tent RJ (2012). Academic Press.
5. ***Principles of Molecular Medicine***. Runge, Marschall S, Patterson (2006). (2nd Edi.), Humana Press.
6. ***Medical Biotechnology***. Judit P & M Keen (2009). 1st Edi. Elsevier Pub.
7. ***Medical Biotechnology***. Jogdand SN (2011). 2nd Edi. Himalaya Publishers.
8. ***Biotechnology-Applying the genetic Revolution***. Clark and Pazdernik (2009). Academic Press
9. ***Basic & Clinical Pharmacology***. Bartram G Katzung (2004). 9th Edi. Mc Graw Hill Publications.
10. ***Text book of biochemistry with Clinical Correlations***. Devlin TM (2002). 5th Edi.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Plant & Microbial Biotechnology (Lab)**		
Course Code	**M24-BTY-307**		
Course Type	**PC-5**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Develop practical skill & acquaint with recent knowledge and techniques in field of microbial & plant biotechnology. They will be able to understand various biological aspects related to organismal, cellular, biochemical and molecular biological. **CLO-2:** Analyse and solve various problems related to microbial and plant biotechnology, launch start-ups and become entrepreneurs for various products and processes. **CLO-3:** Understand bio-safety measures related to microbial and plant biotechnology techniques. **CLO-4:** Imbibe the value of team spirit & as well as work independently to write and manage their research experimentation.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		4 Hours	

Part B-Contents of the Course

	Practical's	Contact Hours
	Practical Exercises 1. Working of fermenter, Fermentation. 2. Production of wine, beer, ethanol. 3. Isolation of industrially important micro-organisms. 4. Screening for lignocellulolytic and pectinolytic micro-organisms. 5. Isolation of protease/lipase/amylase producing micro-organisms. 6. Isolation of keratinase producing micro-organisms. 7. Production of Xylanase/Cellulase/Pectinase by microbes & activity estimation. 8. Development of selection system for transformants. 9. *Agrobacterium* mediated transformation. 10. Reporter gene (GUS) assay. 11. Isolation of Plant genomic DNA from the leaves tissue. 12. Isolation of plasmid vector from *Agrobacterium*.	120

	13. Restriction digestion of plant genomic DNA. 14. Transgene detection by amplification. 15. Southern blotting of DNA. 16. Plants crude extracts preparation from plant tissues. 17. Isolation of essential oils from plant tissues.	
	Total Contact Hours	120

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Practicum	**30**	**Practicum**	70
	❖ Class Participation	05	Lab record, Viva-Voce, Write-up and Execution of the Practical	
	❖ Seminar/Demonstration/Viva-Voce/Lab records, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-Learning Resources

Recommended Books:

1 ***Introduction to Biotechnology***. HS Chawla (2009), 3rd Ed., Science Pub.

2. ***Plant Tissue Culture Manual***. Lindsey (2007). Springer (India) Publication.

3. ***Molecular Cloning: A Laboratory Manual***. Sambrook & Maniatis (2002). Cold Spring Harbor Laboratory Press, New York.

4. ***Plant Biotechnology:*** Laboratory Manual. Chawla HS (2008). Oxford & IBH Publishing Co. Pvt. Ltd. India.

5. ***Molecular Cloning: A Laboratory Manual.*** Sambrook & Russell (2007) 3rd Edi. (Vol.1-3). Cold Spring Harbor Laboratory Press, New York.

6. ***Manual of Industrial Microbiology & Biotechnology.*** Demain & Davies (1999) 2nd Edi. ASM Press, Washington D.C.

7. ***Practical Manual of Biotechnology***: Applied Sciences. Mahajan R, *et al.* (2010). Vayu Education of India.

8. ***Microbiology***: A Laboratory Manual. Cappuccino & Welsh (2016). 11th Edi. Pearson Education Ltd.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**Biotechnology**		
Semester	**III**		
Name of the Course	**Molecular Genetics & Immunology/Molecular Medicine & Diagnostic Techniques (Lab)**		
Course Code	**M24-BTY-308**		
Course Type	**PC-6**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Learn techniques such as induction of mutations, replica plating, metaphase chromosome preparation, banding techniques, various assays such as comet, SCE and micronucleus as biomarkers of genotoxicity to detect genetic damage. **CLO-2:** Work with techniques such as PCR-RFLP for SNP detection, DNA Fingerprinting, isolation of peripheral blood lymphocytes, determination of TLC and DLC for use in clinical and medical fields. **CLO-3:** Get trained in diagnostic techniques for detection of different diseases. **CLO-4:** Get acquainted with the qualitative and quantitative estimation of antigen.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		4 Hours	

Part B-Contents of the Course

	Practicals	Contact Hours
	Practical Exercises 1. Spontaneous and induced mutations. 2. Metaphase chromosome preparation, chromosome banding techniques. 3. Sister chromatid exchange assay using peripheral blood lymphocytes for genotoxicity studies. 4. Single Cell Gel Electrophoresis to detect DNA damage. 5. Analysis of Micronucleus as biomarker of genotoxicity using buccal epithelial cells. 6. To determine IC_{50} of a toxic compound. 7. To determine TLC and DLC in human blood smear. 8. Isolation of Lymphocytes from peripheral blood. 9. Serum preparation and serological reactions-Agglutination and Precipitation. 10. To perform Enzyme-linked Immunosorbent assay. 11. To perform immunodiffusion by Mancini and Ouchterlony method (single	120

	or double). 12. To perform immuno-electrophoresis with a given antigen-antibody system. 13. To perform DNA fingerprinting analysis. 14. PCR-RFFLP for SNP detection.	
	Total Contact Hours	30

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Practicum	**30**	**Practicum**	70
	❖ Class Participation	05	Lab record, Viva-Voce, Write-up and Execution of the Practical	
	❖ Seminar/Demonstration/Viva-Voce/Lab records, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-Learning Resources

Recommended Books:

1. ***Introductory Practical Biochemistry***. Sawhney & Singh (2005). Alpha Science Publishing Pvt. Ltd. India.

2. ***Principles & Techniques of Biochemistry & Molecular Biology.*** Wilson & Walker.

3. ***Practical Manual of Biotechnology***: Applied Sciences. Mahajan R. *et al.* (2010). Vayu Education of India.

4. ***Molecular Biology Techniques:*** Susan (2nd Edi.) Academic Press

5. ***Molecular Biology:*** Principles and Practice. Michael *et al.*, (3rd Edi.). WH Freeman.

6. ***Experiments in Microbial Genetics***. Tortora (4th Edi.). John Wiley & Sons, Inc.

7. ***Medical Biotechnology:*** Techniques & Applications. Raymond & Wegner (2nd Edi.). Academic Press.

8. ***Cytogenetic Laboratory Management:*** Chromosomal, FISH and Microarray-Based Best Practices and Procedures. Susan Mahler Zneimer.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**III**		
Name of the Course	**Biotechnology & Human Welfare**		
Course Code	**M24-OEC-303**		
Course Type	**OEC**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Know the tools and techniques used in industrial biotechnology. Learn about basics of fermentation and downstream processing, uses of microbes, industrial application of enzymes and enzyme engineering. **CLO-2:** Learn about role of biotechnology in waste management and bioremediation. Describe various concepts and principles of biosensors and biofuels. **CLO-3:** Understand basic concepts of molecular diagnostics, vaccines, gene therapy, DNA fingerprinting, *etc.* **CLO-4:** Get acquainted with the uses of transgenic plants and animals. Get acquainted with the latest knowledge of different areas of biotechnology and will be able to solve problems requiring interdisciplinary approach.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: *The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.*

Units	**Topics**	**Contact Hours**
I	**Industrial Biotechnology:** Introduction, Isolation and screening of microbes, approaches for strain development, Production of organic compounds, enzymes and antibiotics by microbes, Types of Fermentation, Downstream processing Enzyme immobilization, Industrial applications of enzymes, Protein and enzyme engineering	08
II	**Environmental Biotechnology:** Role of Biotechnology in the treatment of waste water, Solid waste management using biotech approaches, Bioremediation: Concept and principles, Bioremediation using microbes and plants, Biofuels, Biosensors.	06

III	**Animal and Medical Biotechnology:** Molecular Diagnostics- DNA/RNA probes, PCR to detect infectious diseases, Monoclonal antibodies- their production and applications. **Vaccines:** live, attenuated, killed, subunit, conjugate and DNA vaccines. **Gene Therapy**: Types of gene therapy, Augmentation & Targeted Gene Therapy. DNA fingerprinting & Forensic analysis, Transgenic animals- mice, cattle, sheep, pigs, fish, *etc*. Biofarming, pharmaceutical products Animal cloning, Bioethics.	08
IV	**Agricultural Biotechnology:** Transgenic plants for biotic (insects, herbicide, fungal and viral resistance) and abiotic stress tolerance. Nutritional quality modifications in crop plants, Molecular Farming (Medically Related Proteins - edible vaccines, plantibodies, *etc*.), Plant secondary metabolites.	08
	Total Contact Hours	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
Theory	15	Theory	35
❖ Class Participation	04	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc*.	04		
❖ Mid-Term Exam	07		

Part C-*Learning Resources*

Recommended Books:

1. ***Biotechnology: Expanding Horizon.*** BD Singh (2010). 3rd Edi. Kalyani Publishers.
2. ***Biotechnology and Genomics***. PK Gupta (2013). 1st Edi. Rastogi Publishers.
3. ***Applying Genetic Revolution***. Clark DV and Pazdernik NJ (2009). Academic Press.
4. ***Hand book of Plant Biotechnology***. Gistou P and Klu H (2004). John Publication.
5. ***Plant Biotechnology:*** Halford NG (2006). John Wiely Publishers.
6. ***Animal Biotechnology.*** Ballinic, Philips JP & Moo Young M (1989). Pergamon Press, NY.
7. ***Molecular Biology of Gene***. Watson JD *et al.* (2007) 6th Edi. Publisher Benjamin Cummings.
8. ***Basic Biotechnology***. Ratlege C & B Kristiansen (2001). Cambridge Univ. Press, London.
9. ***Microbial Biotechnology***. Glazer and Nikaido, WH Freeman & Company, New York.
10. ***Biotechnology in crop improvement***. HS Chawla. International Book Distributing Company.
11. ***Genetics to Gene Therapy***: Mol. Pathology of Human Disease. 1st Edi (1994). BIOS Scientific Pub.
12. ***Medical Biotechnology***. Jogdand SN (2011). 2nd Edi. Himalaya Publishers.
13. ***Introduction to Nanobiotechnology***. Niemeyer and Mirkin (2003). Wiley, VCH-Publishers.
14. ***Medical Biotechnology***. Glick BR, Delovitch and Patten (2014). ASM Press.
18. ***Lehninger Principles of Biochemistry***. Nelson & Cox. Freeman & Company, NY.
19. ***Principles of Fermentation Technology***. Stansbury PF *et al.* (1997). Pergmon Press, Oxford.
20. ***Biotechnology: A Textbook of Industrial Microbiology***. Cruger & Cruger (2002), 2nd Edition.

Session: 2025-26

Part A-Introduction

Name of Programme	**M.Sc. Biotechnology**
Semester	**IV**
Name of the Course	**Animal & Medical Biotechnology**
Course Code	**M24-BTY-401**
Course Type	**CC-11**
Level of course **(Anx-1)**	**500-599**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Learn techniques of animal cloning, embryo transfer, production of transgenic animals and their applications for human welfare. **CLO-2:** Gain thorough understanding of Nucleic acid & protein therapeutics, role of stem cells in biomedical research, gene therapy & DNA fingerprinting. **CLO-3:** Learn advanced techniques such as nanobiotechnology and pharmacogenomics and gain insight into clinical aspects of Biotechnology. **CLO-4:** Have a broad understanding of the animal and biomedical research for biotechnological applications and explore their ideas of new vision of animal and medical biotechnology.

	Theory	Practical	Total
Credits	4	0	4
	4	0	4
Teaching Hours per week	4	0	30
Internal Assessment Marks	30	0	70
End Term Exam Marks	70	0	100
Max. Marks	100	0	
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Introduction to Animal Biotechnology**: Scope, global perspective & new horizons, economically important livestock breeds, Model animals in animal biotechnology & genetic engineering; An overview of animal cell culture techniques-cell lines, cell culture, cell viability assays, cryopreservation of cells **Transgenic Animals:** Principles of transgenesis; Methods of gene transfer-DNA microinjection, Retroviral & embryonic stem cell methods, Electroporation, Biolistic, lipofection; selectable markers, Application of transgenic animals-mice, sheep, pigs, goats, cows, fish; Molecular pharming, Case studies of transgenic animal models.	15
II	**Animal Cloning:** Concept of animal cloning, cloning from embryonic and adult cells, Somatic cell nuclear transfer technique, Embryo splitting, Creation of Dolly, Molly and Polly, challenges and limitations; applications of animal cloning. **Embryo Transfer Technology:** Definition, Super-ovulation, Artificial Insemination, *In-vitro* fertilization, embryo evaluation, embryo transfer in cattle,	16

	Applications of embryo transfer technology. **Stem Cell Technology:** Definition, classification-adult and embryonic stem cells; hematopoietic, mesenchymal and neural stem cells, properties and characteristics of pluripotent and multipotent stem cells, induced pluripotent stem cells, therapeutic cloning for embryonic stem cells, stem cell based therapies and clinical applications.	
III	**Nucleic Acid Therapeutics**: Anti-sense RNA, Ribozyme, Aptamers, DNAzymes, RNAi, Zinc Finger Nucleases. **Protein Therapeutics**: Pharmaceuticals (Tumour Necrosis Factor, Human Growth Hormone, Interferon. *etc.*), Recombinant Antibodies (Human Monoclonal Antibodies, Hybrid Human Mouse Monoclonal Antibody, Anticancer Antibodies), Enzymes (DNase, Alginate Lyase, Alpha 1 Antitrypsin, Phenyl Ammonia Lyase, Glycosidases). **Gene Therapy**: Definition, Types of gene therapy-Gene augmentation, gene inhibition, Gene editing; *in-vitro* and *in-vivo* gene therapy, viral and nonviral vectors for gene transfer, gene therapy for SCID, Cancer, Neurological disorders, Ethical issues.	16
IV	**Nanobiotechnology**: Introduction, Types and Synthesis of Nanoparticles, Protein based Nanostructures, applications of Nanoparticles, Nanobiosensors, Drug & Gene Delivery, Disease Diagnostics & Therapy, Risk Potential of Nanomaterials. **Pharmacogenomics**: Concept, Role of Genetic Variations in different responses of individuals to drugs, Pharmacogenomics and Industry, Personalized Medicine, DNA Fingerprinting in Forensic Sciences.	13
	Total Contact Hours	60

Suggested Evaluation Methods

	Internal Assessment: 30		**End Term Examination: 70**	
	Theory	30	**Theory**	**70**
	❖ Class Participation	05	Written examination	
	❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Culture of Animal Cells:*** A Manual of Basic Technique. Freshney (2016). 7th Edi. Wiley-Blackwell.
2. ***Animal Biotechnology***: Ranga MM (2018). 3rd Edi. Agrobios (2018).
3. ***Medical Biotechnology***. Glick BR, Delovitch and Patten (2014). ASM Press.
4. ***Stem Cell Biology***. Marshak L (2001). Cold Spring Harbor.
5. ***Medical Biotechnology***. Judit and Keen (2009). 1st Edi. Elsevier Publications.
6. ***Medical Biotechnology***. Jogdand SN (2011). 2nd Edi. Himalaya Publishers.
7. ***Biotechnology: Applying the Genetic Revolution***. Clark and Pazdernik (2009). Academic Press.
8. ***Concepts in Biotechnology***. Balasubramanian & Dharmalingam (2004). 2nd Edi. University Press.
9. ***Biotechnology***. Satyanarayan (2008). Books and Allied (Pvt.) Ltd.
10. ***Biotechnology***: Expanding Horizon. BD Singh (2010). 3rd Edi. Kalyani Publishers.
11. ***Biotechnology and Genomics***. Gupta PK (2013). Rastogi Publications Meerut, India
12. ***Introduction to Nanobiotechnology***. Niemeyer and Mirkin (2003). Wiley VCH, Publishers.
13. ***Principles of Gene manipulation and Genomics***. Primose SB and Twyman RM (2006). 7th Edi. Blackwell
14. ***Basic & Clinical Pharmacology***. Bartram Katzung (2004). 9th Edi. Mc Graw Hill Publications.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Environmental Biotechnology**		
Course Code	**M24-BTY-402**		
Course Type	**CC-12**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Have an overview of the developments in the field of Environmental Biotechnology with special emphasis on the role of microbes in mitigating environment pollution as well as potability of water and its quality control. **CLO-2:** Describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment. **CLO-3:** Understand role of microbes in bioremediation of environmental pollutants & also utility of microbes in mineral & oil recovery. **CLO-4:** Understand applications of Biotechnology in environment monitoring.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Environmental Biotechnology:** An Overview, Concept, Scope & Market Biological Control of Air-Pollution, Bacterial examination of H_2O for Potability, testing of H_2O for Physiochemical Parameters including BOD & COD. **Solid Waste:** Sources and Management (Composting, Vermi-composting and Methane Production).	15
II	**Waste Water:** Origin, Composition and Treatment. Physical, Chemical and Biological Treatment of Waste Water. **Aerobic Processes:** Activated Sludge, Oxidation Ponds, Trickling Filter Towers and Rotating Discs.	16

	Anaerobic Processes: Anaerobic Digesters, Anaerobic Filters and Up flow Sludge Blanket Reactors. Microbiology and Biochemistry of Aerobic and Anaerobic Waste Water Treatment Processes. **Treatment of Industrial Effluents:** Distillery Effluent, Paper and Pulp Mill Effluent, Tannary Effluent, Textile Dye Effluent, Removal of Heavy Metals from Waste Waters.	
III	**Bioremediation:** Introduction of Bioremediation, Advantages & Applications, Types of Bioremediation, Natural (Attenuation), *Ex-situ* & *In-situ*, Bioaugmentation and Biostimulation, Solid Phase and Slurry Phase Bioremediation. **Biodegradation:** Aerobic versus Anaerobic Degradation, Microbial basis of Biodegradation, Biodegradation of Xenobiotics, Microbial Degradation of Pesticides. **Biotechnological Methods of Pollution Detection:** General Bioassays in Pollution Monitoring, Cell Biology in Environmental Monitoring, Molecular Biology in Environmental Monitoring & Biosensors in Environmental analysis.	15
IV	**Microbial Insecticides:** Bacteria, Fungi and Viruses. Use of r-DNA Technology to enhance efficacy Microbial Insecticides. Bio-fertilizers, Microbes in oil Recovery and Bioleaching. **Bio-deterioration:** Bio-deterioration of stored Plant Food Materials, Leather, Wool, Metals, Textiles, Stone & Related Building. Control of Microbial Bio-deterioration.	14
	Total Contact Hours	60

Suggested Evaluation Methods

	Internal Assessment: 30		**End Term Examination: 70**	
	Theory	**30**	**Theory**	**70**
	❖ Class Participation	05	Written examination	
	❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Environmental Biotechnology:*** Principles and Applications. Bruce & McCarty (2020). 2nd Edi. Mc Graw Hills Publisher.
2. ***Introduction to Biodeterioration***. Allsopp and Seal. ELBS/Edward Arnold Publisher.
3. ***Advanced Environmental Biotechnology***. SK. Agarwal (2005). APH Publishing, New Delhi.
4. ***Environmental Biotechnology:*** Biodegradation, Bioremediation, Sustainable Development. Jeyabalan & Abdullah (2016). Apple Publisher Academic Press.
5. ***Environmental Science and Technology***. Stankey EM (1997). Lewis Publishers, New York.
6. ***Microbial Biotechnology:*** Basic Research and Applications Singh *et al.* (2020). Pub. Springer
7. ***Biodegradation and Bioremediation***: Soil Biology. Singh & Ward (2004). Pub. Springer

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Food Biotechnology**		
Course Code	**M24-BTY-403**		
Course Type	**DEC-3**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Understand the scope of food biotechnology and acquaint with recent theoretical knowledge and techniques related to production and processing of biotech foods and supplements. **CLO-2:** Comprehend about the food additives that are relevant to processed food industry for shelf-life extension, processing aids and sensory appeal. **CLO-3:** Gain the knowledge of food packaging, its importance and its interaction with food products. They would be able to launch start-ups and become entrepreneurs for huge different types of products and processes related to food and packaging. **CLO-4:** Learn about food preservation techniques, methods for the microbiological examination, concepts of food safety, quality control, ethical issues and regulatory compliances related to food biotechnology. **CLO-5:** Develop biotech savvy integrated personality with ability to communicate and write effectively on scientific principles and ideas in the field of food biotechnology.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: *The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.*

Units	Topics	Contact Hours
I	**Biotech Foods and Supplements:** Introduction to Food Biotechnology and related Industries. **Transgenic Plant Foods:** Carbohydrates, Proteins, Vitamins Nutritional Quality Improvement of Food Crops by Genetic Engineering, Safety of GM Food Crops. **Dietary Supplements:** Single Cell Protein (SCP) Production, Mushrooms Production Technology, Large Scale Production of Algae and Yeast.	15
II	**Food Additives & Preservation Techniques:** Food Additives-Definitions, Need for Food Additives. **Classification & Functions of Different Additives:** Thickeners, Antioxidants,	15

	Colouring Agents, Flavouring Agents, Sweeteners, Emulsifiers, Flour Improvers. **Probiotics:** Production & Importance of Probiotics. **Preservation Techniques:** Refrigeration & Freezing, Dehydration, Heating, Irradiation, Antimicrobial Agents used in Food Preservation.	
III	**Fermented Foods & Food Packaging:** Cheese Production Technologies. **Fermented Foods of India:** Dairy Products, Cereal & Legume Foods, Vegetables/Fruits, Meat & Fish. **Introduction to Food Packaging:** Definition, Factors involved in Evolution and Selection of a Food Package, Types of Packaging Materials & their Functioning Properties. **Aseptic Packaging of Foods:** Sterilization Techniques of Packaging Materials, Methods for Microbiological Examination of Foods. Advantages/functions & Disadvantages associated with Packaging of Foods.	15
IV	**Food Safety and Quality Control:** Introduction to Concepts of Food Safety & Food Quality Assurance, Food Adulteration, Nature of Adulterants, Methods of Evaluation of Food Adulterants & Toxic Constituents, Hazard Analysis & Critical Control Point (HACCP). **Role of International Regulatory Agencies:** US-FDA and International Organization for Standards (ISO). **Indian Food Laws & Standards:** Prevention of Food Adulteration (PFA) Act, Fruit Products Order (FPO), Meat Products Order (MPO), Cold Storage Order (CSO), Role of AGMARK Standard, Bureau of Indian Standards (BIS) and Food Safety & Standards Authority of India (FSSAI).	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory**	**70**
❖ Class Participation	05	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Essential Genes***. Benjamin Lewin (2007). Pearson Edu. International.
2. ***Genomes***. TA Brown (2017). Garland Science, Taylor & Francis, NY.
3. ***Introduction to Food Biotechnology***. Skariyachan & Abhilash (2012). CBS, Publishers, New Delhi.
4. ***Food Processing and Preservation***. Sivasankar B (2002). Prentice Hall of India Pvt. Ltd., New Delhi.
5. ***Food Processing and Preservation***. Khetarpaul N (2005). Dya Publishing House, New Delhi.
6. ***Food Packaging: Principles and Practice***. Robertson GL (2012). 3rd Edi. Taylor & Francis Pub.
7. ***Novel Food Packaging Techniques***. Ahvenainen R (2003). CRC Press.
8. ***Innovations in Food Packaging***. Han JH (2005). Elsevier Academic Press.
9. ***Total Quality Assurance for the Food Industries***. Gould & Gould (2001). CTI Pub. Inc. Baltimore.
10. ***Biotechnology:*** Food Fermentation in Microbiology, Biochemistry & Technology. Josh VK (2009).
11. ***Food Microbiology***. Adams & Moss (2008). RSC Publishing Cambridge, UK.
12. ***Food Microbiology***. Frazier & Westhoff (2013). TATA McGraw-Hill Pub. Pvt. Ltd. New Delhi.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Genomics, Proteomics & Metabolomics**		
Course Code	**M24-BTY-405**		
Course Type	**DEC-4**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Understand the concept of genome, proteome and metabolome and their correlation with each other. **CLO-2:** Learn about genetic organization of nuclear genomes of prokaryotes and eukaryotes, features of eukaryotic organelle genomes, genome evolution and molecular phylogenetics. **CLO-3:** Conceptualize about different techniques used for proteomics and metabolomics. **CLO-4:** Learn application of techniques for further research studies in Genomics, Proteomics and Metabolomics.		
Credits	Theory	Practical	Total
	4	0	4
	4	0	4
Teaching Hours per week	4	0	30
Internal Assessment Marks	30	0	70
End Term Exam Marks	70	0	100
Max. Marks	100	0	
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Genetic Features of Eukaryotic Nuclear Genomes:** Where are Genes in a Nuclear Genome? How are Genes organized in a Nuclear Genome? How many genes are there and What are their Functions? **Genetic Features of Prokaryotic Genomes**: How are Genes organized in a Prokaryotic Genome? How many genes are there and what are their Functions? Prokaryotic Genomes and Species Concept. **Eukaryotic Organelle Genomes:** Origins of Organelle Genomes, Physical features of Organelle Genomes, Genetic Content of Organelle Genomes.	14
II	**Genome Evolution:** Genomes, First Ten Billion Years, Origins of Genomes, Acquisition of new Genes by Duplication events from other Species. **Non-coding DNA & Genome Evolution:** Transposable Elements & Genome Evolution. **Human Genome:** Last Five Million Years, Molecular Phylogenetics-Origin of Molecular Phylogenetic, Phonetics & Cladistics, Key features of DNA based Phylogenetic Trees, Applications of Molecular Phylogenetics, Evolutionary	15

	relationships between Humans & other Primates, Origins of AIDS, Molecular Phylogenetic as a tool in the study of Human Prehistory.	
III	**An Introduction to Proteomics, Proteome**: Areas of Proteomics, Structural Proteomics, Functional Proteomics, Expression Proteomics. **Approaches for Study of Proteomics:** Separation of Proteins by 2D-Electrophoresis, Mass-Spectrometry (ESI and MALDI), Amino-Acid Sequencing of Protein by Edman Method (Traditional Approach), Identification of Proteins by Tandem Mass-Spectrometry, Shot-gun Proteomics. **Protein Sequence Databases**: Peptide Fingerprinting/Mapping, Determination of 3D-Structure of Protein by X-ray Diffraction & NMR-Spectroscopy. **Protein Expression Profiling:** 2D-differential in Gel Electrophoresis, Isotope-Coded Affinity Tag (ICAT) Method for Quantitative Proteome Analysis, **Various Approaches for Determining Function of a Protein:** Protein-Protein Interaction (PPI) using two Hybrid System, Complementation, Tandem Affinity Purification (TAP) Tag Method, PPI Mapping, Protein Microarrays-Analytical, Reverse phase, Functional.	16
IV	**Introduction to Metabolism, Metabolic Pathways, Metabolite, Metabolomics:** Methods/Approaches Employed to Study Metabolism, Inter-relationship between Genome, Transcriptome, Proteome and Metabolome, Methods for Measurement of Metabolites Level/Concentration. **Metabolic Regulation & Control:** Homeostasis & Metabolic Control, Metabolic Flux, Metabolic Control Analysis, Demand-Supply Analysis, Mechanisms of Flux Control, Regulation of Glycolysis in Muscle as an Example of Metabolic Regulation. **Metabolic Engineering**: Transfer of Gene/s, Partial Pathways, Entire-Biosynthetic Pathways for creating new Products. Metabolic Engineering for Altering/redirecting Metabolite Flow, Limitations in Metabolic Engineering.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory		**Theory**	**70**
❖ Class Participation	30	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	05		
❖ Mid-Term Exam	10		
	15		

Recommended Books:

1. ***Principles of Gene manipulation and Genomics***. Primrose & Twyman. 7th Edi. Blackwell Publisher

2. ***Biochemistry***. Voet & Voet. John Wiley and Sons, USA

3. ***Biochemistry.*** Satyanarayana & Chakrapani. Books and Allied (Pvt.) Ltd. India.

4. ***Lehninger Principles of Biochemistry***. Nelson & Cox. Freeman & Company, NY.

5. ***Introductory Practical Biochemistry***. Sawhney & Singh. Narosa Publishing Pvt. Ltd. India.

6. ***Text book of Biotechnology***. Dubey. S Chand & Company Ltd. India.

7. ***Principles & Techniques of Biochemistry & Molecular Biology.*** Wilson & Walker.

8. ***Molecular Biotechnology***. Glick & Pasternak. ASM Press, Washington DC.

9. ***Genomes***. TA Brown (2017). Garland Science, Taylor & Francis, NY.

10. ***Human Molecular Genetics***. Tom Strachan & Andrew P Read (2011), 4th Edi. Garland Science.

11. ***Elements of Biotechnology***. PK Gupta, 4th Reprint (2nd Edition): 2019-2020, Rastogi Pub.

12. ***Fundamentals of Enzymology***. Devasena. Oxford University Press.

13. ***Enzymology***. Devasena. Oxford University Press.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Biosafety, Bioethics & IPR issue of Biotechnology**		
Course Code	**M24-BTY-406**		
Course Type	**DEC-4**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Understand the basic issues of biosafety, bioethics and IPR arising from the commercialization of biotech products. **CLO-2:** Follow the regulatory framework in their future venture to ensure product safety and benefit the society. **CLO-3:** Understand social, economic and legal issues related to biotechnology. **CLO-4:** Perform project management & choosing processing the most appropriate form of IPR for protection of their research/end product.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	**Biosafety:** Introduction, Historical background, Biosafety in the Laboratory, Laboratory Associated Infections and other Hazards, Biosafety Management for Environmentally Safe use of Biotechnology, Biosafety Guidelines, Recommended Biosafety Levels for Infectious Agents and Infected Animals. **Definition of GMOs & LMOs:** Good Manufacturing Practices (GMP) and Good Lab Practices (GLP), Overview of National Regulations and Relevant International Agreements including Cartagena Protocol, Roles of Institutional Biosafety Committee (IBSC), RCGM, GEAC, MEC, SBCC, DLC and RDAC, Guidelines for Research in Transgenic Sciences and Release of GMOs to Environment, Bioterrorism and Convention on Biological Weapons.	15
II	**Bioethics:** Ethical Issues related to Biotechnology Research, Ethical Issues associated with Consumptions of Genetically Modified Foods and other Products, Ethical Implications of Human Genome Project, Social and Ethical Implications of Biological Weapons. **Bioremediations & Environmental Impacts of using GMOs:** Ethics of	15

	Patenting & its Impact on Biodiversity Rich Developing Countries, Use of Animals for Research & Testing and Alternatives for Animals in Research.	
III	**Social, Economic & Legal Issues Related to Biotechnology:** Public Education of Processes of Biotechnology involved in Generating new Forms of Life for Informed Decision Making, Testing of Drugs on Human Volunteers. **Human Cloning & Gene Therapy:** Ethical & Social Issues, Organ Transplantation-Ethical & Legal Implications, Research Focus to Address the Need of Poor Environment.	15
IV	**Intellectual Property Rights:** Intellectual Property Rights (IPR) & its Protection, Patenting & Procedure involved in Application of Patents & Granting of a Patent, Compulsory Licenses, Legislations covering IPR's in India. **Patent and Rights:** Patent Search, Patent Cooperation Treaty (PCT), Traditional Knowledge Commercial Exploitation, Farmers Rights, Plant Breeder's Rights, International & National Conventions on Biotechnology and Related Areas-GATT, TRIPS, Biodiversity Convention, *etc.*	15
	Total Contact Hours	60

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Theory	**30**	**Theory**	**70**
	❖ Class Participation	05	Written examination	
	❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-*Learning Resources*

Recommended Books:

1. ***Biotechnology and Safety Assessment.*** Thomas & Fuch (2002). Academic Press.
2. ***Biological Safety Principles and Practices***. Fleming & Hunt (2000). ASM Press.
3. ***Bioethics & Biosafety.*** Sateesh MK (2008). IK Publishers.
4. ***Intellectual Property Rights on Biotechnology.*** Singh K (2008). BCIL, New Delhi.
5. ***Dynamics of Entrepreneurial Development and Management***. Desai V (2007). Himalaya Publishing.
6. ***Patent law and Entrepreneurship***. Singh & Kaur (2006). Kalyani Publishers.
7. ***IPR, Biosafety and Bioethics***. Goel and Prashar (2013). Pearson Education, India.
8. Important Web 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; www.patentoffice.nic.in ; www.iprlawindia.org ; http://www.cbd.int/biosafety/background.shtml

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Food & Environmental Biotechnology (Lab)**		
Course Code	**M24-BTY-407**		
Course Type	**PC-7**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Have knowledge and hands-on training of techniques for culture of yeast and mushrooms. **CLO-2:** Learn practical knowledge of methods to test the potability of different water samples. **CLO-3:** Have practical understanding of techniques to test various qualitative aspects of diverse water & food samples. **CLO-4:** Choose most appropriate technique for food and water testing and imbibe the value of team spirit while working together during practical sessions.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		4 Hours	

Part B-Contents of the Course

	Practical's	Contact Hours
	Practical Exercises 1. Preparation of synthetic medium for yeast culture. 2. To study the production of yeast. 3. To study the cultivation of mushrooms. 4. To study the various sterilization and food preservation techniques. 5. Estimation of (a) Iodine (b) Saponification (c) Acid values of fats & Oils. 6. Determination of moisture, total crude fat in a given food sample. 7. Determination of Acidity & pH in food sample/beverages. 8. Determination of total, non-reducing and reducing sugars. 9. To determine TDS, DO, COD, BOD of given water sample. 10. Total bacterial population of given samples of water by standard plate count (SPC) technique. 11. To check the potability of given water sample. 12. To check presence of coliform in given water sample by Multiple-tube fermentation test or most probable number test (Presumptive, confirmed and completed test).	120

	13. To check the presence of coliforms using membrane filter method. 14. To check the presence of faecal and non- faecal coliforms in the given water sample and confirmation of faecal coliforms. 15. To determine the quality of given milk sample. 16. Microbial production of Sauerkraut.	
	Total Contact Hours	120

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Practicum	**30**	**Practicum**	70
	❖ Class Participation	05	Lab record, Viva-Voce, Write-up and Execution of the Practical	
	❖ Seminar/Demonstration/Viva-Voce/Lab records, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-Learning Resources

Recommended Books:

1. ***Food and Agricultural Organization:*** Manuals of Food Quality Control.

2. ***Introductory Practical Biochemistry***. Sawhney & Singh (2005). Alpha Science Publishing Pvt. Ltd. India.

3. ***Practical Manual of Biotechnology***: Applied Sciences. Mahajan R, *et al.* (2010). Vayu Education of India.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Animal & Medical Biotechnology; Biosafety, Bioethics & IPR/ Genomics, Proteomics & Metabolomics (Lab)**		
Course Code	**M24-BTY-408**		
Course Type	**PC-8**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Get acquainted with different tools and techniques used in Animal and medical Biotechnology. Get hand on Training in different cell culture techniques, cell viability/Proliferative assays, cryopreservation techniques, Transfection methods **CLO-2:** Work with techniques for genetic variation detection such as single nucleotide polymorphism for use in pharmacogenomics; and DNA Fingerprinting for use in forensic science. **CLO-3:** Get acquainted with techniques of genomics, proteomics and metabolic engineering. Get acquainted with practical knowledge of IPR, Biosafety and Bioethics. **CLO-4:** Get acquainted with techniques/process of patent filing. Have knowledge of lab rules and safety measures to be taken in the Lab. They will imbibe the value of team spirit while working together during practical sessions.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		4 Hours	

Part B-Contents of the Course

	Practical's	Contact Hours
	Practical Exercises 1. To study organization set up of Animal Biotechnology lab, aseptic techniques used, Cell culture techniques 2. Isolation and culture of lymphocytes; Cell viability/cytotoxicity and proliferation assays 3. Cryopreservation techniques 4. Detection of Single nucleotide polymorphism 5. To perform DNA fingerprinting analysis 6. Synthesis of nanoparticles and nanocomposites 7. Engineering E. coli for Enhanced Production of a Metabolite 8. Protein Identification and Quantification Using Mass Spectrometry	120

	9. Genome Browsing and Annotation Using Bioinformatics Tools 10. Whole Genome Sequencing Data Analysis 11. Performance of GLP in Biotechnology laboratory. 12. Survey of different methods of Public Education on Biotech Processes involved in generating new forms of life for informed decision making. 13. Study of Indian Legislation on Protection of Product and Services in Agri-Biotech Sector. 14. Process of implementation of rDNA guidelines in India. 15. Perform patent search for specific category 16. Protocol for filling patent and other IPR 17. To study NCBI Homepage and virtual library via NCBI 18. To perform BLAST for Nucleotide Sequence and for protein sequence 19. To study phylogenetic analysis 20. To study PDB structure 21. Comparative study of: Gene Bank/ Genepept and FASTA	
	Total Contact Hours	120

	Suggested Evaluation Methods			
	Internal Assessment: 30		**End Term Examination: 70**	
	Practicum	**30**	**Practicum**	70
	❖ Class Participation	05	Lab record, Viva-Voce, Write-up and Execution of the Practical	
	❖ Seminar/Demonstration/Viva-Voce/Lab records, *etc.*	10		
	❖ Mid-Term Exam	15		

Part C-Learning Resources

Recommended Books:

1. ***Manual of Animal Biotechnology***. Ramadass & Kumanan (1st Edi.). New Age, International Pvt. Ltd. Publishers.
2. ***Culture of Animal Cells:*** A Manual of Basic Technique. Freshney (2016). 7th Edi. Wiley-Blackwell.
3. ***Medical Biotechnology:*** Techniques & Applications. Raymond & Wegner (2nd Edi.). Academic Press.
4. ***The Proteomics Protocols Handbook***. John Walker. Humana Press.
5. ***Plant Biotechnology:*** Principles & Applications. Zainul *et al.*, (2017). Springer.
6. ***IPR, Biosafety and Bioethics***. Goel and Prashar (2013). Pearson Education, India.
7. ***Animal Cell Culture***: Practical Approach. John (2000) 3rd Edi. Oxford Press.
8. ***Animal Cell Culture Methods In***: Methods in Cell Biology. Jenni Mather & David Barnes. Academic Press.
9. Important Web Links: http://www.w3.org/IPR/
10. Important websites: http://www.wipo.int/portal/index.html; www.patentoffice.nic.in; http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html; www.iprlawindia.org http://www.cbd.int/biosafety/background.shtml.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**Biotechnology**		
Semester	**IV**		
Name of the Course	**Entrepreneurship & Diagnostic Techniques**		
Course Code	**M24-BTY-409**		
Course Type	**EEC**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Assess their personal characteristics and interests to that of the "successful" entrepreneur, identification and assess sources of support for small businesses and entrepreneurs. **CLO-2:** Perform project management, licensing and release of GMOs or their products in India. **CLO-3:** Understand about diagnostic test strips, microbial identification methods and biosensors for biomolecules. **CLO-4:** Know the collection and handling of biosamples, cancer biomarkers and their diagnosis, test methods of hematology and biochemical test of body fluids. Understand use of various techniques in diagnostic field.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 Hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking CLOs into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics	Contact Hours
I	***Entrepreneurship:*** Entrepreneurship & principles of entrepreneurial development, Qualities of an entrepreneur, Functions & types of entrepreneurs. Industrial licensing, venture capital. Biotechnological industries in India and potential job opportunities, Challenges of bio-entrepreneurship in India and measures to promote bio-entrepreneurship in India.	07
II	**Project Management:** Formulation, Identification and selection based on size, Technological assessment, Project cost and market potential. Process of drug development and licensing; Guidelines for release of GMOs and their derived products in India.	08

III	Immuno-chromatographic diagnostic test strips and their advantages. Fast methods (biochemical and molecular) for microbial identification and confirmation. Sterile disk method to test antibiotic sensitivity. Biosensors for detecting biomolecules and use in physiological monitoring, advantages and limitations of biosensors.	07
IV	Specimen Collection and handling of different types of clinical specimens. **An overview of cancer biomarkers:** types, tests and importance in management of cancer disease. Hematological tests (*e.g.,* complete blood count, erythrocyte sedimentation rate, blood group and Rh factor, coagulation tests and interpretation). Biochemical analysis of various fluids and other samples (*e.g.,* liver function tests, kidney function tests, thyroid function tests, lipid profile tests, sugar test). Applications of techniques such as ELISA, PCR, HPLC and Mass Spectroscopy in diagnostics.	08
	Total Contact Hours	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
Theory	15	Theory	35
❖ Class Participation	04	Written examination	
❖ Seminar/Presentation/Assignment/Quiz or Class test, *etc.*	04		
❖ Mid-Term Exam	07		

Recommended Books:

1. ***Biotechnology: Expanding Horizon.*** BD Singh (2010). 3rd Edi. Kalyani Publishers.
2. ***Experiments in Microbiology***: Plant Pathology & Biotechnology. Aneja KR (2007). New Age, International Pvt. Ltd.
3. ***Introductory Practical Biochemistry***. Sawhney & Singh (2005). Alpha Sci. Pub. Pvt. Ltd.
4. ***Practical Manual of Biotechnology***: Applied Sciences. Mahajan R, *et al.* (2010). Vayu Education of India.
5. ***Handbook of Bioentrepreneurship***. Thomas Brenner & Holger Patzelt (2008). Springer, NY.
6. ***Basic Biotechniques for Bioprocess & Bioentrepreneurship***. Bhatt *et al.*, (2022). Elsevier Science Publishing Co. Inc. Academic Press Inc.
7. ***Dynamics of Entrepreneurial Development & Management***. Desai (2007). Himalaya Publishing.
8. ***Indian Entrepreneurship in Biotechnology Comes of Age.*** Gupta *et al.*, (2012).
9. ***Introduction to Bioentrepreneurship***. Sinha *et al.*, (2021).
10. ***Textbook of Medical Laboratory Technology.*** Praful, Godkar and Darshan.
11. ***Practical Clinical Biochemistry:*** Methods and Interpretations. Ashfaq Ahmed.
12. ***Clinical Pathology and Clinical Biochemistry***. Abhijit Chaudhari.
13. ***Clinical Biochemistry:*** Theory and Practical. Ramesh, Nandini and Anuradha.

Session: 2025-26			
Part A-Introduction			
Name of Programme	**M.Sc. Biotechnology**		
Semester	**IV**		
Name of the Course	**Dissertation/Project work**		
Course Code	**M24-BTY-410**		
Course Type	**Dissertation/Project work**		
Level of the course	**500-599**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO). After completing this course, the learner will be able to:	**CLO-1:** Conduct effective literature searches, compile information and critically evaluating relevant literature review to formulate a clear researchable theme and research plan. **CLO-2:** Select and applying appropriate research methodologies, data collection, and analysis. Apply practical and theoretical knowledge to perform research and to solve scientific problems. **CLO-3:** Communicate research findings clearly and concisely in both written and oral formats. Drawing conclusions and suggesting future research directions. **CLO-4**: Develop a research project by identifying gaps in the literature that makes a meaningful contribution to their field of study. Learn working independently and collaboratively as a team with supervisors and colleagues.		
Credits	Theory	Practical	Total
Teaching Hours per week			12
Evaluation of Dissertation			
Viva-Voce			200
Max. Marks			100
Examination Time			300
Part B-Contents of the Course			
The student will undertake independent research on a chosen research topic in the field of life sciences under faculty supervision. The student will write a well-structured dissertation that would reflect critical thinking, methodology, results and analysis and scholarly engagement with primary and secondary texts.			
Suggested Evaluation Methods			
The dissertation will be evaluated by an external examiner out of 300 marks.			
Evaluation of Dissertation: 200		**Viva-Voce: 100**	
Total: 200 + 100 = 300			
Part C-*Learning Resources*			
Recommended Books: 1. ***Introductory Practical Biochemistry***. Sawhney & Singh (2005). Alpha Sci. Pub. Pvt. Ltd. 2. ***Textbook of Medical Laboratory Technology.*** Praful, Godkar and Darshan. 3. ***Practical Clinical Biochemistry:*** Methods and Interpretations. Ashfaq Ahmed. 4. ***Clinical Pathology and Clinical Biochemistry***. Abhijit Chaudhari. 5. ***Clinical Biochemistry:*** Theory and Practical. Ramesh, Nandini and Anuradha.			

6. ***Principles & Techniques of Biochemistry & Molecular Biology.*** Wilson & Walker.
7. ***Plant Tissue Culture Manual***. Lindsey (2007). Springer (India) Publication.
8. ***Molecular Cloning: A Laboratory Manual***. Sambrook & Maniatis (2002). Cold Spring Harbor Laboratory Press, New York.
9. ***Molecular Cloning: A Laboratory Manual.*** Sambrook & Russell (2007) 3rd Edi. (Vol.1-3). Cold Spring Harbor Laboratory Press, New York.
10. ***Manual of Industrial Microbiology & Biotechnology***. Arnold I Demain & Julian E Davies (1999). 2nd Edition, ASM Press, Washington DC.
11. ***Molecular Biology Techniques:*** Susan (2nd Edi.) Academic Press
12. ***Molecular Biology:*** Principles and Practice. Michael *et al.*, (3rd Edi.). WH Freeman.
13. ***Experiments in Microbial Genetics***. Tortora (4th Edi.). John Wiley & Sons, Inc.
14. ***Medical Biotechnology:*** Techniques & Applications. Raymond & Wegner (2nd Edi.). Academic Press.
15. ***Cytogenetic Laboratory Management:*** Chromosomal, FISH and Microarray-Based Best Practices and Procedures. Susan Mahler Zneimer.
16. ***How to Write a Thesis***. Murray & Rowena (2017). 4th Edi. Open University Press.
17. ***Scientific Thesis Writing and Paper Presentation***. Gurumani. MJP Publishers, Chennai, India