Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus
for
Post Graduate Programme

M.Sc. Biotechnology

(3rd and 4th Semester)

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With CBCS-LOCF
With effect from the session 2025-26 (in phased manner)

DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF LIFE SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**3**		
Name of the Course	Plant Biotechnology		
Course Code	M24-BTY-301		
Course Type	CC-9		
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 recent knowledge and learn techniques related to organization of plant genome, vectors, methods of genetic transformation and other aspects that are important for production of transgenic plants and their molecular analysis. Understand the gene silencing and gene stacking. CLO 2: Understand plant 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 and bioreactors for them and technologies for extraction and isolation of secondary metabolites. CLO 4: Understand IPR, bio-safety and 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 course learning outcomes (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.			

Unit	Topics	Contact Hours
I	**Plant genetic transformation:** Organization of plant genome – Nuclear genome, Chloroplast genome and mitochondrial genome. 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, 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.	20
II	**Strategies for introducing biotic and abiotic stress resistance/tolerance:** Viral resistance; Fungal resistance; Insect resistance; Herbicide resistance; Various abiotic stresses (like drought, salinity, temperature). **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 colours and production of enzymes of industrial importance.	16
III	**Plant cells as bio-factories for the production of secondary metabolites:** Secondary metabolites, types of cell culture systems used for production of secondary metabolites and advantages of *in vitro* production of secondary metabolites. 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 biochemicals), Immobilization of plant cells, Bioreactors for plant cell, organ and immobilized plant cell cultures, biotransformation, permeabilization of cells and removal of secreted products.	14
IV	**Intellectual Property Rights, Biosafety and Ethical Issues:** Intellectual property rights (IPR): Patents, trade secrets, copyright, Geographical indications, trademarks; GATT & TRIPPS; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Clean gene technology; Current status of transgenic crops; Bane and boon of GM crops; Concerns about GM crops– environmental, biosafety and ethical issues**.**	10
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**

• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Malik Z. A., Usha K., Kamaluddin and Athar A. (2017) Plant Biotechnology: Principles and Applications. Springer Nature, Singapore.
2. Elements of Biotechnology by P. K. Gupta, 4th Reprint (2nd Edition): 2019-2020, Rastogi pub.
3. Plant Genetic Engineering Vol. 1 - 6 (2003) Singh R. P and Jaiwal P. K. (Eds.), Sci tech publishing LLC, USA.
4. Introduction to Biotechnology (2009) by H. S. Chawla, 3rd edition, Science publishers, USA Gene transfer to plants by Potrykus I. and Spangenberg G., Springer Verlag, Germany.
5. Plant tissue culture – Theory and Practice (2005) by Bhojwani S. S. and Razdan M. K., Elsevier publication.
6. Plant biotechnology (2000) by Hammond J, Mc Garvey P. and Yusibov V. (Eds.) Springer Verlag, Germany.
7. Plant Biotechnology – The genetic manipulation of plants (2nd edition, 2008) by Slater A., Scott N. and Fowler M., Oxford pub.
8. Practical application of Plant Molecular Biology (1997) by Henry R.J., Chapman and Hall.
9. Plants, genes and agriculture (2002) by Chrispeels M.J., Sadava D.E, 2nd ed. Jones & Bartlett pub., UK.
10. Nigel G Halford (2018) Crop Biotechnology: Genetic Modification and Genome Editing. World Scientific publishing Europe Ltd., London.

Session: 2025-26			
Part A – Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**3**		
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 and various types of fermentations. CLO 2: Attain knowledge about designing of industrial strains and 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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	Microbial Biotechnology: Scopes application and challenges. Biology of industrial micro- organisms: Industrial microorganisms, growth metabolism regulation, substrate assimilation/ product formation. Isolation and preservation of industrially important microorganisms. Fermentation system; batch and continuous system, fed batch system, multistage system. Solid state fermentation and its applications.	15
II	Overproduction of primary & secondary metabolites: Use of mutation	15

	selection and recombination techniques. Fermentation raw materials: Media for industrial fermentations; criteria used in media formulation. Fermenter/bioreactor design and operation; types of fermenter, stirred tank reactor, bubble column reactor, airlift reactor, packed bed reactor, fluidized bed reactor and trickle bed reactor, agitation and aeration in a reactor, mass transfer. Foam formation and control.	
III	Industrial production of alcoholic beverages (whisky, wine and beer) and improvement by genetic engineering. Microbial production of food additives: amino acids, nucleosides and vitamins. Microbial production of industrial chemicals: Bulk organic chemicals ethanol, citric acid, acetic acid, gluconic acid, glycerol acetone and butanol. Microbial production of healthcare products: antibiotics (Penicillin & tetracyclines), Vaccines (Bacterial cells and bacterial toxins)	15
IV	Microbial inoculants: Food starter cultures; baker's yeast, starter cultures for the dairy industry, meat starter cultures, Biomass production: single cell protein (SCP) production; microbial inoculants; Microbial transformation of steroids and 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, extracellular polysaccharides and enzymes.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Stansbury P.F. et al. (1997), Principles of Fermentation Technology, Pergmon Press Oxford.
2. Ward O.P., (1998), Fermentation Biotechnology – Principles, Process and Products. Prentice Hall Publishing, New Jersey.
3. Microbial Biotechnology: Basic Research and Applications (2020). Edit. Singh *et al*. Pub. Springer
4. Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Science Publishers
5. Arnold I. Demain and Julian E. Davies (1999), Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press, Washington D.C.
6. Glazer and Nikaido (1998) Microbial Biotechnology by WH Freeman & Company, New York.
7. Cruger and Cruger (2002), Biotechnology – A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**3**		
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 and 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 and 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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	**Eukaryotic Genome Structure and Organization:** Genome sequence and chromosome diversity, variation in chromosome number, Special features of metaphase chromosomes, Chromosome banding, Genome size and complexity, organization and content of human genome, Repetitive DNA, Microsatellites, genome wide repeats, Split genes, overlapping genes, cryptic genes, Retrogenes, Multigene families, Pseudo genes. Nucleosome-Basic Structure, spatial arrangements of histones, chromatosome, Solenoid model,	15

	Chromatin domains, Chromatin modifications **The 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	
II	**Transcription Regulation in Prokaryotes:** Positive and Negative control of transcription, Repression and activation, Organization and regulation of Lac, Trp and Ara operon in *E. coli.,* Organization of genome in lambda phage (early, middle and late genes), Regulation of lytic cascade, Antitermination, 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 and negative regulation of Yeast galactose utilizing genes Signal transduction and control of transcriptional regulators, Gene silencing, Epigenetic gene regulation	18
III	**Regulatory RNAs:** Riboswitches, Interfering RNA (RNAi) and gene expression, Short interfering RNA (siRNA) and its functions, MicroRNA 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, Pyrosequencing), 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 footprinting **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:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Essential genes (2007), Benjamin Lewin, Pearson education international 2.
2. Genomes-4 (2017) T.A Brown. Garland science, Taylor & Francis, New York.
3. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primrose and R.M Twyman, Blackwell publishing.
4. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2017) 5th edition, Bernard R Glick and Jack J Pasternak. ASM press, Washington.
5. Human Molecular Genetics (2011) 4^{th}edition, Tom Strachan & Andrew P Read, Garland science.
6. Molecular Biology of Gene (2007) 6th edition, Watson, Baker *etal*, Levine and Losick, Pearson education Inc.
7. Principles of Genetics (2006), 8th Edition, Gardener *et.al,* John Wiley, New York.
8. Genes XII, (2017) (Ed.12^{th}), Lewin, B. Jones and Bartlett Publishers
9. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
10. Principles of Genetics (2006), 8th edition, Snustad and Simmons, Wiley
11. Analysis of Genes and Genomes, (2017) 9^{th} edition Daniel L. Hartl and Bruce Cochrane, Jones and Bartlett Publishers.
12. Biotechnology and Genomics (2013) Gupta P. K. 1^{st} Edition. Rastogi publishers

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**3**		
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 the 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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	**Introduction and overview:** Introduction and overview of immunology, cells of immune system, innate and cellular immunity, physical and chemical barriers, cellular defenses, inflammation, receptors involved in innate immune system, cells and organs involved in adaptive immune response, fate of antigen after penetration, interrelationship between innate and acquired immunity.	15
II	**Antigens, antibodies and their interactions:** Requirements of immunogenicity, primary and secondary responses, major classes of antigens, basic structure of antibodies, antibody classes and biological	15

	activity, antigenic determinants on immunoglobulins, immunoglobulin super family, organization and expression of immunoglobulin genes, antigen-antibody interactions: immunoprecipitation, agglutination, ELISA, immunofluorescence, flow cytometry	
III	**Generation of B-cell and T-cell responses:** Complement system and its activation, Structure and role of Major Histocompatibility Complex, T-cell receptor- structure, complex and accessory membrane molecules, thymic selection of T-cells, T-cell activation and differentiation, B-cell maturation, activation and proliferation, humoral response, Cytokines- properties and receptors.	15
IV	**Immune system in health and disease:** Hypersensitivity reactions- their types and mechanism, Cancer and the 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:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Benjamin E. Immunology – A short course 4th Edition, John Wiley, New York
2. Kuby J. Immunology,8th Edition, W.H. Freeman & Co., New York
3. Roitt, I.M. Essential Immunology, 12th Edition, Oxford Black Well Science, London
4. Tizard I.R. Immunology – An introduction, 9th Edition, Philadelphia Saunders College press.
5. Gupta P.K. Biotechnology and Genomics, Rastogi Publications Meerut
6. Ommerville et al. Alcamo's Fundamentals of Microbiology, Jones and Barteett Publishers.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**3**		
Name of the Course	Molecular Medicine and Diagnostics		
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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	Chromosomes Anomalies and Disorders - Numerical (polyploidy, aneuploidy, autosomal, sex- chromosomal) & Structural (deletion, duplication, translocation, inversion, isochromosome, 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	15

	Mitochondrial disorders– Mitochondrial Homeostasis and Parkinson disease	
II	Immunological approaches to detect protein biomarkers of disease-ELISA, Sandwich ELISA for measuring disease associated proteins, diagnosing autoimmune diseases by indirect ELISA, Immunoassays for infectious disease, protein arrays to detect polygenic disorder, 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	15
III	Introduction to metabolic disorders and metabolic 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& its related pathogenesis. Molecular endocrinology in health and disease. Cancer and cell cycle, Gene therapy as a potential tool to cure human diseases. 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.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Glick B.R, Delovitch, T. L and Patten, C. L. Medical Biotechnology, ASM press 2014
2. Rob Elles, Molecular Diagnosis of Genetic Diseases (Methods in Molecular Medicine), (Ed. 2nd), Humana Press (2003).
3. Dennis, W. Ross, Introduction to Molecular Medicine, (Ed. 3rd), Springer (2002).
4. Tent R.J., Molecular Medicine: Genomics to Personalized Healthcare (Ed.4th), Academic Press (2012).
5. Marschall S. R, C. Patterson. Principles of Molecular Medicine (Ed. 2nd), Humana Press (2006).
6. Judit Pongracz and K. Mary, Medical Biotechnology 1st Edition, Elsevier publications, 2009
7. Jogdand S. N. Medical Biotechnology 2nd Edition Himalaya publishers 2011
8. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
9. Bartram G. Katzung, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications, 2004.
10. Devlin TM, Text book of biochemistry with Clinical Correlations (5th edition), 2002

Session: 2025-26			
Part A - Introduction			
Name of the Programme	M.Sc. Biotechnology		
Semester	**3**		
Name of the Course	Lab Course based on Plant Biotechnology & Microbial Biotechnology		
Course Code	M24-BTY-307		
Course Type	PC-5		
Level of the course	500-599		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Develop practical skill and acquaint with recent knowledge and techniques in the field of microbial and 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 and 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	0	4 hours	

Part B-Contents of the Course		
Practicals		**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 and activity estimation 8. Development of selection system for transformants 9. *Agrobacterium* mediated transformation	120

	10. Reporter gene (GUS) assay. 11. Isolation of Plant genomic DNA from the leaves tissue 12. Isolation of plasmid vector from *Agrobacterium* 13. Restriction digestion of plant genomic DNA 14. Transgene detection by amplification 15. Southern blotting of DNA 16. Plants metabolites crude extract preparation from plant tissues. 17. Isolation of essential oils from plant tissues.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	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/e-resources/LMS:

1. H. S. Chawla (2009) Introduction to Biotechnology, 3rd edition, Science publishers, USA.
2. Lindsey K. (2007) Plant Tissue Culture Manual. Springer (India) publication.
3. Molecular Cloning: A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
4. H. S. Chawla (2008) Plant Biotechnology- Laboratory Manual. Oxford & IBH publishing Co. Pvt. Ltd. India.
5. Molecular Cloning: A Laboratory Manual 3rd edition (2007), Vol. 1 -3, J. Sambrook and D.W. Russell, Cold Spring Harbor Laboratory Press, New York.
6. Arnold I. Demain and Julian E. Davies (1999), Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press, Washington D.C.
7. Mahajan R, Sharma J and Mahajan R.K. (2010) Practical Manual of Biotechnology for students of Biochemistry, Microbiology, Biotechnology and other branches of Applied Sciences. Vayu Education of India. ISBN No.978-93-80712-22-2.
8. Cappuccino JG and Welsh C (2016) Microbiology-A Laboratory Manual, 11th edition, Pearson Education Limited.

Session: 2025-26			
Part A - Introduction			
Name of the Programme	M.Sc. Biotechnology		
Semester	**3**		
Name of the Course	Lab Course based on Molecular Genetics, Immunology/ Molecular Medicine and Diagnostics		
Course Code	M24-BTY-308		
Course Type	PC-6		
Level of the course	500-599		
Pre-requisite for the course (if any)	N.A.		
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	0	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. 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 IC50 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	120

	10. To perform Enzyme-linked Immunosorbent assay 11. To perform immunodiffusion by Mancini and Ouchterlony method (single or double) 12. To perform immuno-electrophoresis with a given antigen-antibody system 13. To perform DNA fingerprinting analysis 14. PCR-RFLP for SNP detection	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	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/e-resources/LMS:

1. Sawhney, S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
2. Wilson, K. and walker, J. Principles and Techniques of Biochemistry & Molecular Biology, Cambridge University Press.
3. Mahajan, R., Sharma, J. and Mahajan, R.K. (2010), Practical Manual of Biotechnology, Vayu Education of India.
4. "Molecular Biology Techniques: A Classroom Laboratory Manual, 2nd edition, Susan J. Karcher. Academic Press
5. Molecular Biology: Principles and Practice, 3rd edition Michael M. Cox, Jennifer A. Doudna, and Michael O'Donnell. W, H Freeman
6. Experiments in Microbial Genetics, 4th Edition Gerard J. Tortora. John Wiley & Sons, Inc
7. Medical Biotechnology: Techniques and Applications, 2ND Edition, Raymond R. Smith and Nicholas C. Wegner. 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 the Programme	M.Sc. Biotechnology		
Semester	**3**		
Name of the Course	Biotechnology and Human Welfare		
Course Code	M24-OEC-303		
Course Type	OEC		
Level of the course (As per Annexure-I)	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 course learning outcomes (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.

Unit	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	8

	Enzyme immobilization, Industrial applications of enzymes, Protein and enzyme engineering	
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	6
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 Gene therapy, Targeted gene therapy. DNA fingerprinting and forensic analysis Transgenic animals- mice, cattle, sheep, pigs, fish etc, Biofarming, pharmaceutical products Animal cloning, Bioethics	8
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.	8
	Total Contact Hours	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Singh B.D. Biotechnology: Expanding Horizon (2010)3rd edition. Kalyani publishers.
2. Gupta P.K. Biotechnology and Genomics (2013) 1st Edition. Rastogi publishers
3. Clark D.V and Pazdernik, N.J Applying Genetic Revolution (2009) Academic Press
4. Gistou, P and Klu, H.H and book of Plant Biotechnology (Vol. I & II). John Publication.2004
5. Halford N.G. Plant biotechnology: current and future applications of genetically modified crops. John Wiely Publishers.2006
6. Ballinic C.A., Philips J.P and Moo Young M.Animal Biotechnology. Pergamon press, New York. 1989.
7. Watson J.D. et al. Molecular Biology of Gene (6th Ed.) Publisher Benjamin Cummings.2007.
8. Ratlege, C. and B. Kristiansen, Basic Biotechnology. Cambridge Univ. Press, London. 2001
9. Glazer and Nikaido , Microbial Biotechnology By WH Freeman & Company, New York.
10. Chawla, H. S. Biotechnology in crop improvement, International Book distributing company.
11. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, (1994).

12. Prescott, Sc and Dunn, C. Industrial Microbiology, McGraw Hill, New York. 1984
13. Jogdand S N. Medical Biotechnology 2nd Edition Himalaya publishers 2008
14. Niemeyer C.M. and Mirkin C.A, Introduction to Nanobiotechnology, Wiley VCH publishers 2003
15. Glick B.R, Delovitch, T.L and Patten, C.L. Medical Biotechnology, ASM press, (2014).
16. Palmer T. and Bonner P.L. Enzymes, East-West Press.
17. Price, N.C. and stevens L. Fundamentals of Enzymology, Oxford University Press.
18. Nelson, D.L. and Cox, M.M. Lehninger principles of Biochemistry, W.H. freeman and Company , NY
19. Stansbury P.F. et al., Principles of Fermentation Technology, Pergmon Press Oxford.
20. Cruger and Cruger, Biotechnology – A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Animal and Medical Biotechnology		
Course Code	M24-BTY-401		
Course Type	CC-11		
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 of animal cloning, embryo transfer, production of transgenic animals and their applications for human welfare. CLO 2: Gain thorough understanding of Nucleic acid and protein therapeutics, role of stem cells in biomedical research, gene therapy and 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.		
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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	**Introduction to Animal Biotechnology-**Scope, global perspective and new horizons, economically important livestock breeds, Model animals in animal biotechnology and 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	15

	microinjection, Retroviral and 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	
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, Superovulation, artificial insemination, In vitro fertilization, embryo evaluation, embryo transfer in cattle, 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	16
III	**Nucleic Acid Therapeutics** -Antisense RNA, Ribozyme, Aptamers, DNAzymes, RNAi, Zinc Finger Nucleases **Protein Therapeutics**-Pharmaceuticals (Tumour Necrosis Factor, Human Growth Hormone, insulin, leptin, Interferon, interleukin- 10 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 and gene delivery, disease diagnostics and therapy; risk potential of nanomaterials **Pharmacogenomic**s-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:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. I Ian Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (Ed. 7th), Wiley-Blackwell (2016).
2. Ranga M.M., Animal Biotechnology, (Ed. 3rd) Agrobios (2018).
3. Glick B.R, Delovitch, T.L and Patten, C.L. Medical Biotechnology, ASM press 2014
4. Marshak L. Stem Cell biology, Cold spring Harbor (2001).
5. Judit Pongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier publications,2009
6. Jogdand, S. N. Medical Biotechnology 2nd Edition Himalaya publishers2011
7. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
8. Balasubramanian, D., Bryce, C.F.A., Jayaraman, K., Green, J. & Dharmalingam, Concepts in Biotechnology, (Ed. 2nd), University Press (2004).
9. Satyanarayan, U., Biotechnology, Books and Allied (P) Ltd. (2008).
10. Singh B.D. Biotechnology: Expanding Horizon (2010), 3rd edition. Kalyani Publishers.
11. Gupta P.K. Biotechnology and Genomics (2013) 1stEdition. Rastogi publishers
12. Niemeyer C.M. and Mirkin C. A., Introduction to Nanobiotechnology, Wiley VCH publishers2003
13. Primose, S.B. and Twyman, R.M. Principles of Gene manipulation and Genomics (7thedition), Blackwell Publisher2006
14. Bartram G. Katzung, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications,2004.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**4**		
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 the role of microbes in bioremediation of environmental pollutants and also utility of microbes in mineral and 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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	**Environmental Biotechnology:** An overview, concept, scope and market Biological control of air pollution. Bacterial examination of water for potability. Testing of water for physiochemical parameters including BOD & COD. Solid waste: Sources and management (composting, vermicomposting 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 and applications; Types of bioremediation, Natural (attenuation), Ex-situ and In-situ, Bioaugmentation and biostimulation, Solid phase and slurry phase bioremediation. **Biodegradation**: Aerobic vs. 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 and biosensors in environmental analysis.	15
IV	**Microbial Insecticides:** Bacteria, fungi and viruses. Use of R-DNA technology to enhance the efficacy microbial insecticides. Biofertilizers, Microbes in oil recovery and bioleaching. Biodeterioration of stored plant food materials, leather, wool, metals, textiles, stone & related building. Control of microbial biodeterioration.	14
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Environmental Biotechnology: Principles and Applications, Second Edition (2020). By Bruce E. Rittman, Perry L. McCarty. Pub. Mc Graw Hills
2. Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.
3. Advanced Environmental Biotechnology by S.K. Agarwal. APH Publishing, New Delhi, (2005).
4. Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development. By Jeyabalan Sangeetha, Devarajan Thangadurai, Muniswamy David, Mohd Azmuddin Abdullah (2016) Pub. Apple Academic Press
5. Environmental Science and Technology. Stankey E.M. (1997), Lewis Publishers, New York.
6. Microbial Biotechnology: Basic Research and Applications (2020). Edit. Singh *et al.* Pub. Springer
7. Biodegradation and Bioremediation: Soil Biology. Singh A. and Ward O.P. (2004), Springer

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**4**		
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 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.		
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 course learning outcomes (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.

Unit	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 the food crops by genetic engineering, safety of GM food crops. Dietary supplements; Single	15

	cell Protein (SCP) production, mushrooms production technology, large scale production of algae and yeast.	
II	**Food additives & preservation techniques:** Food additives-definitions, need for food additives, classification and functions of different additives: thickeners, antioxidants, 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.	15
III	**Fermented foods and Food Packaging:** Cheese production technologies; Fermented foods of India: dairy products, cereal and legume foods, vegetables/fruits, meat and fish; Introduction to Food Packaging: definition, levels of food packaging, factors involved in the evolution and selection of a food package. Types of packaging materials and their functioning properties; Aseptic packaging of foods: sterilization techniques of packaging materials; Methods for the microbiological examination of foods. Advantages/ functions and disadvantages associated with packaging of foods.	15
IV	**Food Safety and Quality Control:** Introduction to concepts of food safety and food quality assurance; Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Hazard analysis and critical control point (HACCP), Role of international regulatory agencies: USFDA and International Organization for Standards (ISO). Indian food laws and 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 and 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:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Skariyachan S and Abhilash M. (2012) Introduction to Food Biotechnology. CBS publishers, New Delhi.
2. Sivasankar, B (2002): Food Processing and Preservation. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Khetarpaul N. (2005). Food Processing and Preservation, Dya Publishing House, New Delhi.
4. Robertson, G.L. (2012). Food Packaging: Principles and Practice (3rd ed.), Taylor and Francis
5. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, (2003).
6. Han, J.H.(Ed.) Innovations in Food Packaging, Elsevier Academic Press, (2005).

7. Food and Agricultural Organization: Manuals of Food Quality Control.
8. Gould, W.A. and Gould, R.W. (2001) Total Quality Assurance for the Food Industries, 3rd edition, CTI Publications Inc. Baltimore.
9. V.K. Josh (2009). Biotechnology: Food fermentation in Microbiology, Biochemistry and Technology, Vol. 1 and 2.
10. Adams M R and Moss M.O. (2008) Food Microbiology. 3rd edition, RSC Publishing Cambridge, UK.
11. Marwaha S.S. and Arora J. K. (2000) Food Processing: Biotechnological Applications. Asiatech Publishers Inc., New Delhi.
12. Frazier W. C. and Westhoff D. C. (2013) Food Microbiology. 5th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Genomics, Proteomics and 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
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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	Genetic Features of Eukaryotic Nuclear Genomes -Where are the genes in a nuclear genome? How are the genes organized in a nuclear genome? How many genes are there and what are their functions? Genetic Features of Prokaryotic Genomes-How are the genes organized in a prokaryotic genome? How many genes are there and what are their functions? Prokaryotic genomes and the species concept Eukaryotic Organelle Genomes-The origins of organelle genomes, Physical features of organelle genomes, The genetic content of organelle genomes	14

II	Genome Evolution-Genomes: the first ten billion years- the origins of genomes, Acquisition of new genes- by duplication events, from other species, Non coding DNA and genome evolution: Transposable elements and genome evolution, The human Genome: the last five million years Molecular Phylogenetics -origin of molecular phylogenetic, phonetics and cladistics, key features of DNA based phylogenetic trees, Applications of molecular phylogenetics- Evolutionary relationships between humans & other primates, the origins of AIDS, molecular phylogenetic as a tool in the study of human prehistory.	15
III	An introduction to Proteomics, Proteome; Areas of Proteomics – Structural proteomics, Functional proteomics, Expression proteomics. Approaches for study of Proteomics: Separation of proteins by Two-dimensional 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 and NMR spectroscopy. Protein expression profiling – 2D differential in–gel electrophoresis, Isotope-coded affinity tag (ICAT) method for quantitative proteome analysis; Various approaches for determining the function of a protein; Protein-protein interaction using two hybrid system, complementation, tandem affinity purification (TAP) tag method; Protein-protein interaction 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 and control – Homeostasis and 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**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Brown T. A. Genomes 3 (2007) Garland Science Publishing, New York, USA.
2. Strachan Tom and Andrew Read, Human Molecular Genetics 4th Edition (2011). Garland Science, Taylor & Francis Group LLC, USA.
3. Primrose, S.B. and Twyman, R.M. Principles of Gene manipulation and Genomics (7th edition), Blackwell Publisher
4. Voet , D and Voet , J.G. Biochemistry, John Wiley and Sons, USA
5. Satyanarayana, U and chakrapani, U. Biochemistry, Books and allied (P) Ltd, India.
6. Nelson, D.L. and Cox, M.M. Lehninger principles of Biochemistry, W.H. freeman and Company, NY
7. Gupta, P.K. Elements of Biotechnology, Rastogi publications, India.
8. Sawhney, S.K. and Singh, R. Introductory Practical Biochemistry, Narosa publishing house Pvt. Ltd. India.
9. Dubey, R.C. A Text book of Biotechnology, S. Chand & company Ltd, India.
10. Price, N.C. and stevens L. Fundamentals of Enzymology, Oxford University Press.
11. Wilson, K. and walker, J. Principles and Techniques of Biochemistry & Molecular Biology, Cambridge University Press.
12. Glick, B.R., Pasternak, J.J. and patten C.L. Molecular Biotechnology, ASM Press. Washington DC.
13. Devasena, T. Enzymology, Oxford University Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Biosafety, Bioethics and IPR matters 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 and 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 course learning outcomes (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.

Unit	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	15

	weapons.	
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 and environmental impacts of using GMOs; Ethics of patenting- and its impact on biodiversity rich developing countries; Use of animals for research and testing and Alternatives for Animals in Research.	15
III	Social, economic and legal issues related to biotechnology: Public education of the processes of biotechnology involved in generating new forms of life for informed decision making; Testing of drugs on human volunteers; Human cloning and Gene therapy - ethical and social issues; Organ transplantation- ethical and legal implications; Research focus to address the need of the poor and of environment.	15
IV	Intellectual Property Rights: Intellectual property rights and IPR protection; Patenting and the procedure involved in the application of patents and granting of a patent; Compulsory licenses; Legislations covering IPR's in India, Patent search; Patent Cooperation Treaty (PCT); Traditional knowledge commercial exploitation; Farmers rights; Plant breeder's rights; International and 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:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Homas, J. A. and Fuch, R. L. Biotechnology and Safety Assessment. Academic Press. (2002).
2. Fleming, D. A., Hunt, D. L., Biological safety Principles and practices. ASM Press. (2000).
3. Sateesh, M. K. Bioethics & Biosafety, IK Publishers. (2008).
4. Singh B. D. Biotechnology: Expanding Horizon. Kalyani; edition (2015)
5. Singh K., Intellectual Property Rights on Biotechnology BCIL, New Delhi. (2008).
6. Singh, I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).
7. Goel and Prashar, IPR, Biosafety and Bioethics, Pearson education, India (2013)
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 the Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Lab Course based on Food and Environmental Biotechnology		
Course Code	M24-BTY-407		
Course Type	PC-7		
Level of the course	500-599		
Pre-requisite for the course (if any)	N.A.		
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	0	4 hours	

Part B-Contents of the Course		
Practicals		**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 value, (b) Saponification value (c) acid value of fats and 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 technique (SPC) 11. To check the potability of given water sample. 12. To check the presence of coliform in given water sample by	120

	Multiple- tube fermentation test or most probable number test (Presumptive, confirmed and completed test) 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.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	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/e-resources/LMS:

1. Food and Agricultural Organization: Manuals of Food Quality Control.
2. Sawhney S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
3. Mahajan R, Sharma J and Mahajan R.K. (2010) Practical Manual of Biotechnology for students of Biochemistry, Microbiology, Biotechnology and other branches of Applied Sciences. Vayu Education of India. ISBN No.978-93-80712-22-2.

Session: 2025-26			
Part A - Introduction			
Name of the Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Lab Course based on Animal and Medical Biotechnology; Biosafety, Bioethics and IPR / Genomics, Proteomics and Metabolomics		
Course Code	M24-BTY-408		
Course Type	PC-8		
Level of the course	500-599		
Pre-requisite for the course (if any)	N.A.		
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	0	4 hours	

Part B-Contents of the Course

	Practicals	**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	120

	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 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	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	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/e-resources/LMS:

1. Manual of Animal Biotechnology, 1st edition, P. Ramadass and K. Kumanan. New Age International (P) Limited, Publishers.
2. Culture of Animal Cells, (6th edition), R. Ian Freshney. Wiley-Liss, 2010.
3. The Proteomics Protocols Handbook, Ed. John M. Walker. Humana Press.
4. Medical Biotechnology: Techniques and Applications, 2ND Edition,Raymond R. Smith and Nicholas C. Wegner. Academic Press.
5. Plant Biotechnology: Principles and Applications by Malik Zainul Abdin, Usha Kiran, Kamaluddin, Athar Ali, Springer, 2017
6. Goel and Prashar, IPR, Biosafety and Bioethics, Pearson education, India (2013)
7. Important Web Links: http://www.w3.org/IPR/
8. Animal Cell Culture - Practical Approach (3rd edition), Ed. John R.W. Masters, Oxford, 2000.
9. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
10. Culture of Animal Cells, (6th edition), R. Ian Freshney. Wiley-Liss, 2010.
11. Important websites:
    http://www.wipo.int/portal/index.html
    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 the Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Entrepreneurship and Diagnostic Lab Techniques		
Course Code	M24-BTY-409		
Course Type	EEC		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)			
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 bio-samples, 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 course learning outcomes (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.

Unit	Topics	Contact Hours
I	Entrepreneurship: Entrepreneurship and principles of entrepreneurial development, Qualities of an entrepreneur, Functions and types of entrepreneurs. Industrial licensing, venture capital. Biotechnological industries in India and potential job opportunities, Challenges of bioentrepreneurship in India and measures to promote bioentrepreneurship in India.	7
II	Project Management: Formulation, Identification and selection based on	8

	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.	
III	Immunochromatographic 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.	7
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.	8
	Total Contact Hours	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Singh B. D. Biotechnology: Expanding Horizon. Kalyani; edition (2015)
2. Desai V, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House (2007).
3. Aneja K.R. (2007) Experiments In *Microbiology*, Plant Pathology And Biotechnology. New Age International Private Limited.
4. Sawhney S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
5. Mahajan R, Sharma J and Mahajan R.K. (2010) Practical Manual. Vayu Education of India.
6. Thomas Brenner, Holger Patzelt (2008) Handbook of Bioentrepreneurship. Springer New York, NY. DOIhttps://doi.org/10.1007/978-0-387-48345-0
7. A. K. Bhatt, R. K. Bhatia and T. C. Bhalla (2022) Basic Biotechniques for Bioprocess and Bioentrepreneurship. Elsevier Science Publishing Co Inc | Academic Press Inc.
8. Gupta, Reena & Malhotra, Bharti & Huddone, et al. (2012). Indian entrepreneurship in biotechnology comes of age.
9. Sinha, Dwaipayan & Singh, Anjana. (2021). Introduction to Bioentrepreneurship. 10.4018/978-1-7998-7411-9.ch001.
10. "Textbook of Medical Laboratory Technology" by Praful B. Godkar and Darshan P. Godkar.
11. "Practical Clinical Biochemistry: Methods and Interpretations" by S. Ashfaq Ahmed.
12. “Clinical Pathology and Clinical Biochemistry" by Abhijit B. Chaudhari.
13. “Clinical Biochemistry: Theory and Practical" by B. Ramesh, R. Nandini and R. Anuradha.

Session: 2025-26			
Part A - Introduction			
Name of the Programme	M.Sc. Biotechnology		
Semester	**4**		
Name of the Course	Dissertation/Project work		
Course Code	M24-BTY-410		
Course Type	Dissertation/Project work		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)			
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
			12
Teaching Hours per week			
Evaluation of Dissertation			200
Viva-Voce			100
Max. Marks			300
Examination Time			
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/e-resources/LMS:

1. Sawhney S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
2. "Textbook of Medical Laboratory Technology" by Praful B. Godkar and Darshan P. Godkar.
3. "Practical Clinical Biochemistry: Methods and Interpretations" by S. Ashfaq Ahmed.
4. “Clinical Pathology and Clinical Biochemistry" by Abhijit B. Chaudhari.
5. “Clinical Biochemistry: Theory and Practical" by B. Ramesh, R. Nandini and R. Anuradha.
6. Wilson, K. and walker, J. Principles and Techniques of Biochemistry & Molecular Biology, Cambridge University Press.
7. Lindsey K. (2007) Plant Tissue Culture Manual. Springer (India) publication.
8. Molecular Cloning: A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
9. Molecular Cloning: A Laboratory Manual 3rd edition (2007), Vol. 1 -3, J. Sambrook and D.W. Russell, Cold Spring Harbor Laboratory Press, New York. 6. Arnold I. Demain and Julian E.
10. Davies (1999), Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press, Washington D.C.
11. "Molecular Biology Techniques: A Classroom Laboratory Manual, 2nd edition, Susan J. Karcher. Academic Press
12. Molecular Biology: Principles and Practice, 3rd edition Michael M. Cox, Jennifer A. Doudna, and Michael O'Donnell. W, H Freeman
13. Experiments in Microbial Genetics, 4th Edition Gerard J. Tortora. John Wiley & Sons, Inc
14. Medical Biotechnology: Techniques and Applications, 2ND Edition, Raymond R. Smith and Nicholas C. Wegner. Academic Press.
15. Cytogenetic Laboratory Management: Chromosomal, FISH and Microarray-Based Best Practices and Procedures, Susan Mahler Zneimer.
16. Murray, Rowena. How to write a thesis. 4th ed., Open University Press, 2017.
17. N Gurumani, Scientific Thesis Writing and Paper Presentation (ISBN: 9788180940835). MJP Publishers, Chennai.

ANNEXURE-I

Levels of Courses

Levels of Courses: Courses shall be coded based on the learning outcomes, level of difficulty, and academic rigor. The coding structure is as follows:

400-499: Advanced courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory, experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year Postgraduate theoretical and practical courses.
(For first year of 2 year PG Programme)

500-599: Advanced courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory, experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the Second year Postgraduate theoretical and practical courses.
(For second year of 2 year PG Programme or for 1 year PG Programme)