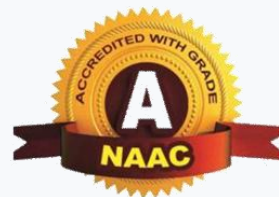




SWAMI VIVEKANAND
SUBHARTI
UNIVERSITY
UGC Approved Meerut



Ordinance No. :- V-141-B-8

(Approved in Academic Council meeting held on 11.03.2026)

Proposed to be ratified in forthcoming executive council)

Evaluation Scheme and Syllabus

of

M.Sc. Biotechnology

TWO – YEAR POST GRADUATE

PROGRAM

(AS PER NEP-2020)

Keral Verma Subharti College of Science

Swami Vivekanand

SUBHARTI UNIVERSITY

Meerut

(Effective from session 2025-26)

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

PROGRAM OBJECTIVES

- PO1: Develop Advanced Knowledge in Molecular, Cellular, and Biotechnological Sciences
- PO2: Build Competence in Advanced Analytical, Biochemical, and Molecular Techniques
- PO3: Foster Scientific Inquiry, Research Methodology, and Problem-Solving Abilities
- PO4: Strengthen Digital, Computational, and Emerging Technology Competence
- PO5: Promote Innovation, Industrial Application, and Entrepreneurship
- PO6: Reinforce Ethical Reasoning, Biosafety, and Responsible Research Practices
- PO7: Enhance Communication, Scientific Writing, and Presentation Skills
- PO8: Encourage Lifelong Learning and Adaptability to Emerging Technologies
- PO9: Strengthen Interdisciplinary Integration for Real-World Biotechnology Problem Solving
- PO10: Foster Holistic Development, Social Responsibility, and Value-Driven Education



PROGRAM OUTCOME

- PSO1: Mastery of Concepts in Molecular, Cellular, and Biotechnological Sciences
- PSO2: Proficiency in Biochemical, Molecular, and Analytical Laboratory Techniques
- PSO3: Ability to Analyze and Interpret Complex Biological Data
- PSO4: Scientific Inquiry, Research Aptitude, and Problem-Solving Skills
- PSO5: Competence in Advanced and Emerging Biotechnological Technologies
- PSO6: Skilled Application of Laboratory Practices and Biosafety Standards
- PSO7: Ethical, Legal, and Social Responsibility in Biotechnology
- PSO8: Effective Scientific Communication
- PSO9: Industry Readiness, Innovation, and Entrepreneurship Skills
- PSO10: Multidisciplinary Integration and Holistic Understanding
- PSO11: Digital Fluency and Professional Competence
- PSO12: Lifelong Learning and Adaptability



CREDIT DISTRIBUTION TABLE

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT							
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE							
Department of Life Science							
M.Sc. Biotechnology (Session 2025-26 onwards)							
		I	II	Internship after II Sem	III	IV	Total
1	Core Course	16	16	4	8	4	44
2	Elective (DEC)	-	-		8	8	16
3	PC/Dissertation/Project Work	8	8		8	12	36
4	Seminar/VAC/OEC/EEC/CHM	2 (Seminar)	2 (CHM)		2 (OEC)	2 (EEC)	8
	Total	26	26		26	26	108



EVALUATION SCHEME

I YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - M.Sc Biotechnology													
SEM:I													
Batch:2025-26			SEM:I										
S. No	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PPT /Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 1	MSBT-101	Advanced Cell and Cancer Biology	4	0	0	4	5	10	15	70	100	
2	Core Course 2	MSBT-102	Microbiology	4	0	0	4	5	10	15	70	100	
3	Core Course 3	MSBT-103	Biochemistry and Biophysics	4	0	0	4	5	10	15	70	100	
4	Core Course 4	MSBT-104	Molecular Biology	4	0	0	4	5	10	15	70	100	
5	Practical I (Based on CC 1 & 2)	MSBT-105P	Cell Biology and Molecular Biology Lab	0	0	4	4	5	10	15	70	100	
6	Practical II (Based on CC 3 & 4)	MSBT-106P	Biochemistry and Microbiology Lab	0	0	4	4	5	10	15	70	100	
7	Seminar I			0	0	2	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - M.Sc Biotechnology													
SEM:II													
Batch:2025-26			SEM:II										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PP T/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 5	MSBT-201	Immunology	4	0	0	4	5	10	15	70	100	
2	Core Course 6	MSBT-202	Enzymology	4	0	0	4	5	10	15	70	100	
3	Core Course 7	MSBT-203	Genetic Engineering	4	0	0	4	5	10	15	70	100	
4	Core Course 8	MSBT-204	Biostatistics and Bioinformatics	4	0	0	4	5	10	15	70	100	
5	Practical III (Based on CC 5 & 6)	MSBT-205P	Immunology and Enzymology Lab	0	0	4	4	5	10	15	70	100	
6	Practical IV (Based on CC 7 & 8)	MSBT-206P	Genetics Engineering and Bioinformatics Lab	0	0	4	4	5	10	15	70	100	
7	CH M 1	MSBT207CHM		2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

SYLLABUS

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: Biotechnology		
Course Code: MSBT-101	Course Title: Advance Cell and Cancer Biology	
Course Outcomes (COs)		
<p>This course builds upon introductory cell biology and introduces students to advanced cellular mechanisms and the fundamentals of cancer biology. After completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • Explain structure-function relationships of advanced cellular organelles and transport systems. • Understand cell signaling pathways and their role in normal and pathological states. • Describe cell cycle regulation, checkpoints, and apoptosis mechanisms. • Analyze the genetic and molecular basis of cancer initiation and progression. • Evaluate anti-cancer strategies and interpret experimental cancer models 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4		
Unit	Topics	NO. of Lectures
I	Advanced Cell Architecture and Dynamics <ul style="list-style-type: none"> • Advanced structure of nucleus and nuclear pore complex. • Endomembrane system and vesicular trafficking. • Cytoskeleton components: microtubules, microfilaments, intermediate filaments, and motor proteins. • Cell polarity and cell migration. 	12
II	Cell Signaling Mechanisms <ul style="list-style-type: none"> • Types of cell signaling: Autocrine, paracrine, endocrine, juxtacrine. • Signal transduction: GPCRs, RTKs, MAPK, PI3K-AKT, Wnt, Notch pathways. • Secondary messengers: cAMP, Ca²⁺, IP₃. • Pathway integration and cross-regulation 	12
III	Cell Cycle and Apoptosis <ul style="list-style-type: none"> • Molecular control of the cell cycle: cyclins, CDKs, checkpoints. • DNA damage response and repair mechanisms. • Apoptosis: intrinsic and extrinsic pathways, Bcl-2 family, caspases, p53 role. 	12
IV	Cancer Biology Basics <ul style="list-style-type: none"> • Characteristics of cancer cells, hallmarks of cancer. • Oncogenes and tumor suppressor genes (e.g., Ras, Myc, p53, Rb). • Genetic and epigenetic changes in cancer. 	14

	<ul style="list-style-type: none"> • Introduction to metastasis, angiogenesis, tumor microenvironment. 	
V	Tumor Progression and Therapeutic Approaches <ul style="list-style-type: none"> • Multistep model of carcinogenesis. • Cancer diagnostics and molecular biomarkers. • Conventional and targeted therapy, immunotherapy basics. • Recent advances: CAR-T cell therapy, CRISPR, cancer vaccines 	10

Suggested Reading Books <ul style="list-style-type: none"> • Alberts B. et al. (2015). <i>Molecular Biology of the Cell</i>. Garland Science. • Lodish H. et al. (2021). <i>Molecular Cell Biology</i>. W.H. Freeman. • Cooper G.M., Hausman R.E. (2018). <i>The Cell: A Molecular Approach</i>. Sinauer Associates. • Weinberg R.A. (2013). <i>The Biology of Cancer</i>. Garland Science. • Hanahan D., Weinberg R.A. (2011). <i>Hallmarks of cancer: the next generation</i>. Cell, 144(5), 646–674. • Vogelstein B., Kinzler K.W. (2004). <i>Cancer genes and the pathways they control</i>. Nature Medicine, 10(8), 789–799. • Robbins & Cotran (2021). <i>Pathologic Basis of Disease</i>. Elsevier. 		
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Practicals- <ol style="list-style-type: none"> 1. Microscopic Analysis of Cell Structure and Organelle Staining 2. Effect of a Chemotherapeutic Agent on Cancer Cell Line (e.g., Doxorubicin or Cisplatin) 3. Cell Cycle Analysis by Flow Cytometry 4. Study of Cell Viability and Proliferation Using Trypan Blue Exclusion and MTT Assay 		
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Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: Biotechnology		
Course Code: MSCBT-102	Course Title: Microbiology	
Course Outcomes (COs)		
<p>This course introduces fundamental and applied aspects of microbiology with emphasis on structure, classification, growth, metabolism, and ecological/clinical relevance of microorganisms. After completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • Understand the diversity and classification of microorganisms including bacteria, archaea, fungi, protozoa, viruses, and algae. • Describe the structural and functional organization of microbial cells. • Explain microbial nutrition, growth, reproduction, and metabolism. • Discuss the role of microbes in human health, environment, industry, and biotechnology. • Apply basic techniques in microbiology including aseptic handling, culturing, staining, and identification. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	

Total Number of Lectures- 4		
Unit	Topics	No. of Lectures
I	<p>Unit I: Introduction and Scope of Microbiology (10 Lectures)</p> <ul style="list-style-type: none"> • History and development of microbiology • Contributions of Leeuwenhoek, Pasteur, Koch, and others • Scope and applications of microbiology (medical, industrial, agricultural, environmental) • Classification and taxonomy of microorganisms (Bergey's Manual overview) • Overview of prokaryotic and eukaryotic microorganisms 	10
II	<p>Unit II: Microbial Cell Structure and Function (12 Lectures)</p> <ul style="list-style-type: none"> • Cell wall and membrane (Gram-positive and Gram-negative bacteria) • Cytoplasmic contents: ribosomes, plasmids, inclusion bodies • Structures external to the cell wall: capsule, flagella, pili, fimbriae • Fungi, algae, protozoa – brief structure and significance • Viruses: structure, classification, and replication 	12
III	<p>Unit III: Microbial Nutrition, Growth, and Control (10 Lectures)</p> <ul style="list-style-type: none"> • Nutritional types of microorganisms • Culture media: types and preparation • Bacterial growth curve, generation time • Physical and chemical factors affecting growth • Sterilization and disinfection methods 	10
IV	<p>Unit IV: Microbial Metabolism and Genetics (10 Lectures)</p> <ul style="list-style-type: none"> • Metabolic pathways: glycolysis, TCA cycle, fermentation, respiration • Overview of microbial photosynthesis and nitrogen fixation • DNA replication, transcription, translation in prokaryotes • Horizontal gene transfer: conjugation, transformation, transduction • Plasmids and antimicrobial resistance 	10
V	<p>Unit V: Applied and Environmental Microbiology (13 Lectures)</p> <ul style="list-style-type: none"> • Role of microbes in environment: soil, water, air • Microbiota and human health (normal flora, probiotics, pathogens) • Industrial microbiology: antibiotics, alcohol, enzymes • Microbial biotechnology and genetic engineering • Microbes in waste management and bioremediation 	13
Suggested Reading Books		

- Pelczar, M.J., Chan, E.C.S., & Krieg, N.R. (2001). *Microbiology*. Tata McGraw-Hill.
- Prescott, L.M., Harley, J.P., & Klein, D.A. (2017). *Microbiology*. McGraw-Hill.
- Tortora, G.J., Funke, B.R., & Case, C.L. (2021). *Microbiology: An Introduction*. Pearson.
- Madigan, M.T., Bender, K.S., Buckley, D.H., et al. (2021). *Brock Biology of Microorganisms*. Pearson.
- Cappuccino, J.G., & Sherman, N. (2013). *Microbiology: A Laboratory Manual*. Pearson.

Practical:

- Introduction to Basic Microbiological Lab Practices and Biosafety
- Preparation and Sterilization of Culture Media (Nutrient Agar, Broth)
- Aseptic Techniques and Streak Plate Method for Pure Culture Isolation
- Gram Staining and Microscopic Examination of Bacteria
- Motility Test by Hanging Drop Method
- Measurement of Microbial Growth by Spectrophotometry
- Effect of pH and Temperature on Microbial Growth
- Antibiotic Sensitivity Testing by Disc Diffusion Method

Programme/Class: Certificate		Year: First (1)	Semester: First (I)
Subject: Biotechnology			
Course Code: MSBT-103		Course Title: Biochemistry and Biophysics	
Course Outcomes (COs)			
After completion of this course, students will be able to:			
<ol style="list-style-type: none"> 1. Analyze the chemical nature and biological functions of carbohydrates, lipids, proteins, and nucleic acids. 2. Explain enzymatic mechanisms and coenzyme functions using kinetic principles. 3. Describe and apply fundamental biophysical principles such as thermodynamics, spectroscopy, and electrophoresis. 4. Demonstrate understanding of biomolecular interactions using structural and analytical tools. 5. Interpret experimental data related to biomolecule behaviour and structure-function relationships. 			
Credits: 4		Core Compulsory	
Maximum Marks: 100		Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4			
Unit	Topics	N0. of Lectures	
I	Unit I: Biomolecules – Carbohydrates and Lipids (10 lectures) <ul style="list-style-type: none"> • Classification and structures of monosaccharides, disaccharides, polysaccharides. • Derivatives: Amino sugars, sugar acids, deoxy sugars. • Glycosidic linkages and structural polysaccharides. 	10	

	<ul style="list-style-type: none"> • Classification of lipids: Fatty acids, triglycerides, phospholipids, sphingolipids, steroids. • Membrane lipids and biological membranes (fluid mosaic model). • Lipoproteins and basics of lipid transport/metabolism. 	
II	Unit II: Proteins and Nucleic Acids (12 lectures) <ul style="list-style-type: none"> • Amino acid classification, chemical properties, and isoelectric point. • Structural levels of proteins – primary to quaternary. • Protein folding, misfolding (e.g., prions), and denaturation. • Structure and functions of DNA and RNA. • Types of RNA and their biological significance. • DNA topology, supercoiling, and chromatin packaging. 	12
III	Unit III: Enzymes and Coenzymes (13 lectures) <ul style="list-style-type: none"> • Enzyme classification (IUBMB), active site, catalytic mechanisms. • Enzyme kinetics: Michaelis-Menten, Lineweaver-Burk plot, K_m, V_{max}, inhibition types. • Role of cofactors and coenzymes: NAD^+, FAD, CoA, TPP, PLP. • Isozymes, allosteric enzymes, feedback regulation. 	10
IV	Unit IV: Biophysical Principles and Techniques (12 lectures) <ul style="list-style-type: none"> • Thermodynamics in biological systems: Free energy, entropy, enthalpy. • Transport phenomena: Diffusion, osmosis, membrane potential. • pH, buffers, Henderson-Hasselbalch equation. • Basic principles of spectroscopy: UV-Vis, fluorescence, IR, circular dichroism. • Chromatography: Paper, TLC, HPLC – principles and applications. • Electrophoresis: PAGE, SDS-PAGE, agarose gel electrophoresis. 	12
V	Unit V: Structural Biology and Molecular Interactions (13 lectures) <ul style="list-style-type: none"> • Molecular forces: Hydrogen bonding, hydrophobic interactions, van der Waals forces. • Molecular modeling and computational biophysics basics. • Introduction to macromolecular crystallography and NMR spectroscopy. • Basics of X-ray diffraction and electron microscopy. • Bioenergetics: ATP, high-energy compounds, oxidative phosphorylation, chemiosmotic theory. 	11

Suggested Reading Books

- Lehninger, A.L., Nelson, D.L., & Cox, M.M. – *Principles of Biochemistry*, W.H. Freeman.
- Voet, D. & Voet, J.G. – *Biochemistry*, John Wiley & Sons.
- Berg, J.M., Tymoczko, J.L., & Gatto, G.J. – *Biochemistry*, W.H. Freeman.
- Satyanarayana, U. & Chakrapani, U. – *Biochemistry*, Elsevier.
- Garrett, R.H. & Grisham, C.M. – *Biochemistry*, Cengage Learning.
- Upadhyay, A., Upadhyay, K., & Nath, N. – *Biophysical Chemistry: Principles and Techniques*, Himalaya Publishing.
- R. Glaser – *Biophysics: An Introduction*, Springer.

Practicals:

- Qualitative tests for carbohydrates, proteins, amino acids, and lipids.
- Isolation and quantification of DNA/RNA.
- Estimation of protein by Lowry and Bradford methods.
- Enzyme assay – amylase/catalase activity and effect of pH and temperature.
- Electrophoresis: Protein/DNA gel electrophoresis (native and SDS-PAGE).
- Spectrophotometric analysis of biomolecules (UV-Vis).
- Buffer preparation and pH measurement.

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: Biotechnology		
Course Code: MSBT-104	Course Title: Molecular Biology	
Course Outcomes (COs)		
This course provides an in-depth understanding of the molecular mechanisms of gene structure, function, and regulation. After completion of this course, students will be able to—		
<ul style="list-style-type: none"> • Understand the structure and replication of DNA and RNA. • Describe gene expression, transcription, and translation processes. • Analyze regulation of gene expression in prokaryotes and eukaryotes. • Gain insights into molecular biology techniques like PCR, blotting, and cloning • Understand mutation, DNA repair, and mobile genetic elements. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4		
Unit	Topics	N0. of Lectures
I	DNA and RNA: Structure and Replication: <ul style="list-style-type: none"> • DNA as genetic material, structure of DNA (A, B, Z forms), supercoiling, structure and types of RNA, • prokaryotic and eukaryotic DNA replication, enzymes involved, semi-conservative mechanism, replication 	10

	fork, Okazaki fragments.	
II	Transcription: <ul style="list-style-type: none"> • Prokaryotic transcription – promoters, RNA polymerase, initiation, elongation and termination, • Eukaryotic transcription – RNA polymerases, transcription factors, • Post-transcriptional modifications (capping, splicing, polyadenylation). 	12
III	Translation and Genetic Code: <ul style="list-style-type: none"> • Structure and role of ribosomes, tRNA, genetic code – properties and degeneracy, • prokaryotic and eukaryotic translation – initiation, elongation, termination; post-translational modifications. 	10
IV	Gene Regulation and DNA Repair: <ul style="list-style-type: none"> • Regulation in prokaryotes (lac and trp operons), Eukaryotic gene regulation – transcriptional and post-transcriptional, • epigenetics, types of mutations, DNA damage and repair mechanisms – mismatch repair, excision repair, SOS response. 	12
V	Recombinant DNA Technology and Molecular Techniques: <ul style="list-style-type: none"> • Restriction enzymes, vectors (plasmids, phage, cosmids), gene cloning, PCR, Southern, • Northern and Western blotting, DNA fingerprinting, CRISPR basics, • applications in health and agriculture. 	11
Suggested Reading Books <ul style="list-style-type: none"> • Molecular Biology of the Cell Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter • Molecular Biology of the Gene James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick • Molecular Cell Biology Harvey Lodish, Arnold Berk, Chris A. Kaiser, et al. 		
Practicals: <ol style="list-style-type: none"> 1. Isolation of Genomic DNA from Plant or Animal Tissue 2. Agarose Gel Electrophoresis of DNA 3. Polymerase Chain Reaction (PCR) – Amplification of a Target Gene 4. Preparation of Competent Cells and Bacterial Transformation 5. DNA Fingerprinting by Simulated or Virtual Lab Method 		

Programme/Class: Certificate		Year: First (1)	Semester: Second (II)
Subject: Biotechnology			
Course Code: MSBT-201		Course Title: Immunology	
Course Outcomes (COs)			
This course provides foundational knowledge of immune mechanisms and their relevance in health and disease. After completion of this course, students will be able to—			
<ul style="list-style-type: none"> • Understand the organization and components of the immune system. • Describe the types and functions of immune responses. • Comprehend antigen-antibody interactions and immune regulation. • Learn about hypersensitivity, autoimmunity, transplantation, and tumor immunity. • Apply basic immunological techniques in laboratory and clinical settings. 			
Credits: 4		Core Compulsory	
Maximum Marks: 100		Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4			
Unit	Topics	N0. of Lectures	
I	Basics of Immunology: <ul style="list-style-type: none"> • Introduction and historical perspective, Types of immunity – innate and adaptive, Cells of the immune system – T cells, B cells, macrophages, dendritic cells, natural killer cells; • Organs of the immune system – primary and secondary lymphoid organs; Cytokines and chemokines 	10	
II	Antigens and Antibodies: <ul style="list-style-type: none"> • Antigen – structure, types, properties, and determinants; Immunoglobulins – structure, classes, functions; • Antigen-antibody interactions – precipitation, agglutination, ELISA, RIA, immunodiffusion, immunoelectrophoresis. 	12	
III	Humoral and Cell-Mediated Immunity: <ul style="list-style-type: none"> • B-cell maturation and activation, class switching; T-cell maturation and activation, • MHC molecules structure and types, antigen processing and presentation, • Complement system classical, alternative, and lectin pathways. 	10	
IV	Hypersensitivity, Autoimmunity, Transplantation & Tumor Immunity: <ul style="list-style-type: none"> • Types I–IV hypersensitivity; Autoimmune diseases – types, examples, mechanisms; Immunosuppression and tolerance; • Transplantation immunology – graft types, rejection, immunosuppressive therapy; • Tumor immunology – immune surveillance and immunotherapy. 	12	

V	Immunological Techniques and Applications: <ul style="list-style-type: none"> • Vaccines – types, principles, and development; • Monoclonal antibodies – production and applications; Flow cytometry, immunofluorescence, western blotting, immunohistochemistry; • Immunodiagnostics – pregnancy tests, infectious disease detection, cancer markers. 	11
Suggested Reading Books <ul style="list-style-type: none"> • Kuby Immunology by Jenni Punt, Sharon Stranford, Patricia Jones • Essential Immunology by Ivan Roitt • Immunology by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne • Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman • Janeway's Immunobiology by Kenneth Murphy • Fundamentals of Immunology by William R. Clark 		
Practicals: <ol style="list-style-type: none"> 1. Identification of Blood Groups (ABO and Rh Typing) 2. Total and Differential Leukocyte Count (TLC and DLC) 3. Enzyme-Linked Immunosorbent Assay (ELISA) 4. Widal Test for Detection of Typhoid Fever 5. Demonstration of Immunoelectrophoresis or Western Blotting 		

Programme/Class: Certificate		Year: First (1)	Semester: Second (II)
Subject: Biotechnology			
Course Code: MSBT-202		Course Title: Enzymology	
Course Outcomes (COs)			
After completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the basic concepts and classifications of enzymes. • Explain enzyme structure, mechanisms of action, and factors affecting activity. • Learn the principles of enzyme kinetics and inhibition. • Explore enzyme regulation, coenzymes, and allosteric control. • Apply knowledge of enzymes in diagnostics, biotechnology, and industrial applications. 			
Credits: 4		Core Compulsory	
Maximum Marks: 100		Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4			
Unit	Topics	N0. of Lectures	
I	Introduction to Enzymes <ul style="list-style-type: none"> • Introduction to Definition, nomenclature and classification of enzymes; 	10	

	<ul style="list-style-type: none"> Historical perspective and scope of enzymology; properties of enzymes catalytic power, specificity, co-factors and coenzymes; prosthetic groups and metal ions in enzyme activity. 	
II	Mechanism of Enzyme Action <ul style="list-style-type: none"> Fischer's lock and key and Koshland's induced fit hypothesis, types of enzyme specificity, active site structure, transition state stabilization, acid-base catalysis, covalent catalysis, Examples of enzymatic mechanisms (e.g., chymotrypsin, lysozyme). 	12
III	Enzyme Kinetics <ul style="list-style-type: none"> Michaelis-Menten kinetics, derivation of the equation, Lineweaver-Burk plot, determination of K_m and V_{max}, Significance of kinetic parameters, multi-substrate reactions, enzyme inhibition: competitive, noncompetitive, uncompetitive, irreversible inhibition. 	10
IV	Regulation of Enzyme Activity <ul style="list-style-type: none"> Allosteric enzymes and models (concerted and sequential), covalent modification, feedback inhibition, isoenzymes, ribozymes, zymogen activation; effect of temperature, pH, and substrate concentration. 	12
V	Applications of Enzymes <ul style="list-style-type: none"> Enzymes in clinical diagnostics, immobilized enzymes: methods and applications; industrial enzymes in food, textile, Detergent, and pharmaceutical industries; recent advances in enzyme engineering and biosensors. 	11

Suggested Reading Books

- Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Trevor Palmer
- Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins Nicholas C. Price and Lewis Stevens
- Principles of Biochemistry Lehninger (David L. Nelson & Michael M. Cox)
- Biochemistry by Jeremy M. Berg, John L. Tymoczko, Lubert Stryer

Practicals:

- Qualitative Test for Enzyme Activity (Amylase on Starch)
- Quantitative Assay of Enzyme Activity (Amylase/Catalase)
- Effect of Temperature on Enzyme Activity
- Effect of pH on Enzyme Activity
- Detection of Enzyme Activity in Clinical Samples (e.g., Urease, Alkaline Phosphatase)

Programme/Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: Biotechnology		
Course Code: MSBT-203	Course Title: Genetic Engineering	
Course Outcomes (COs)		
This course introduces the principles and techniques of genetic engineering. After completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the tools and techniques involved in genetic manipulation. • Gain knowledge about vectors, cloning, and gene expression systems. • Learn the applications of recombinant DNA technology in various fields. • Understand biosafety guidelines and ethical considerations. • Apply genetic engineering knowledge to research and industry-based innovations. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4		
Unit	Topics	N0. of Lectures
I	Introduction to Genetic Engineering <ul style="list-style-type: none"> • History, scope and significance of genetic engineering. • Molecular tools in gene manipulation: restriction enzymes, ligases, DNA polymerases, nucleases, reverse transcriptase, topoisomerase. • Agarose gel electrophoresis and DNA purification techniques. 	10
II	Cloning Vectors and Strategies <ul style="list-style-type: none"> • Plasmids, bacteriophages, cosmids, • BACs, YACs as vectors. Features of ideal cloning vectors. DNA ligation strategies. • Competent cells and transformation techniques: chemical and electroporation. 	12
III	Gene Cloning and Expression <ul style="list-style-type: none"> • Construction of recombinant DNA. Screening of recombinant clones (blue-white screening, colony PCR). • Expression vectors: prokaryotic and eukaryotic systems. Fusion proteins and protein purification tags. 	10
IV	Techniques in Genetic Engineering <ul style="list-style-type: none"> • Polymerase Chain Reaction (PCR): types and applications. Southern, Northern, and Western blotting. • DNA sequencing (Sanger and NGS basics). Site-directed mutagenesis and gene silencing (RNAi). 	12

V	Applications and Biosafety <ul style="list-style-type: none"> • Applications in medicine, agriculture, and industry. Transgenic plants and animals. • CRISPR-Cas9 basics. Biosafety levels, containment, guidelines (DBT, WHO). • Ethical and legal aspects of genetic manipulation. 	11
Suggested Reading Books <ul style="list-style-type: none"> • Principles of Gene Manipulation and Genomics – Sandy B. Primrose & Richard Twyman • Molecular Cloning: A Laboratory Manual – Joseph Sambrook & David W. Russell • Genetic Engineering – Smita Rastogi and Neelam Pathak • Gene Cloning and DNA Analysis – T.A. Brown • Molecular Biotechnology: Principles and Applications – Bernard R. Glick, Jack J. Pasternak • Biotechnology – U. Satyanarayana 		
Practicals: <ol style="list-style-type: none"> 1. Isolation of Plasmid DNA from Bacterial Cells 2. Agarose Gel Electrophoresis of DNA 3. Restriction Digestion of Plasmid or Genomic DNA 4. Polymerase Chain Reaction (PCR) for Gene Amplification 5. Preparation of Competent Cells and Bacterial Transformation with Plasmid DNA 		

Programme/Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: Biotechnology		
Course Code: MSBT-204	Course Title: Biostatistics and Bioinformatics	
Course Outcomes (COs)		
<p>This course provides foundational and applied knowledge of statistical techniques and computational tools used in biological data analysis. Upon completion, students will be able to:</p> <ul style="list-style-type: none"> • Understand the basic principles of biostatistics and their relevance in biological research. • Apply appropriate statistical methods to analyze biological data. • Interpret results from statistical tests and visualize biological datasets. • Understand the basic concepts of bioinformatics and sequence analysis. • Utilize bioinformatics tools for gene/protein analysis and molecular modeling. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4		
Unit	Topics	NO. of Lectures

I	Introduction to Biostatistics Definition and scope of biostatistics, Types of data: qualitative and quantitative, Data presentation: tables, charts, histograms, pie charts, Measures of central tendency: mean, median, mode Measures of dispersion: range, variance, standard deviation	10
II	Probability and Distributions <ul style="list-style-type: none"> • Concepts of probability and probability rules. • Types of distributions: normal, binomial, Poisson. • Z-scores and standard normal distribution. • Sampling techniques and sampling distributions. • Central Limit Theorem. 	12
III	Statistical Inference and Hypothesis Testing <ul style="list-style-type: none"> • Concept of null and alternative hypothesis. • Type I and II errors, significance level, p-value. • t-test (paired and unpaired), chi-square test, ANOVA. • Correlation and regression analysis. • Introduction to non-parametric tests. 	10
IV	Fundamentals of Bioinformatics <ul style="list-style-type: none"> • Introduction and scope of bioinformatics. • Biological databases: NCBI, EMBL, DDBJ, UniProt. • Sequence file formats: FASTA, GenBank. • Sequence retrieval and BLAST. • Sequence alignment: pairwise and multiple (Clustal Omega, MUSCLE). 	12
V	Applications of Bioinformatics <ul style="list-style-type: none"> • Gene prediction tools and genome annotation. • Phylogenetic tree construction and evolutionary analysis. • Protein structure prediction (primary to quaternary). • Molecular docking and drug design basics. • Introduction to omics technologies: genomics, proteomics, transcriptomics. 	11

Suggested Reading Books

- Daniel, W.W. (2018). *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley.
- Khan, I.A., and Khanum, A. (2004). *Fundamentals of Biostatistics*. Ukaaz Publications.
- Mount, D.W. (2004). *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor Laboratory Press.
- Lesk, A.M. (2013). *Introduction to Bioinformatics*. Oxford University Press.
- Rastogi, S.C., Mendiratta, N., and Rastogi, P. (2008). *Bioinformatics: Methods and Applications*. PHI.
- Baldi, P., and Brunak, S. (2001). *Bioinformatics: The Machine Learning Approach*. MIT Press.

Practicals:

- Graphical representation of biological data (bar chart, histogram, pie chart using Excel/SPSS/R).
- Calculation of mean, median, mode, standard deviation from biological data.
- Performing t-test and chi-square test on sample datasets.
- Sequence retrieval from NCBI and analysis using BLAST.
- Multiple sequence alignment using Clustal Omega.
- Construction of phylogenetic tree using online tools (e.g., MEGA/PhyloT).
- Protein structure visualization using PDB and tools like RasMol or PyMOL



SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - M.Sc Biotechnology													
SEM:III													
Batch:2025-26			SEM:III										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PPT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)	Total	Remark
1	Core Course 9	MS BT-301	Plant Biotechnology	4	0	0	4	5	10	15	70	100	
2	Core Course 10	MS BT-302	Animal Biotechnology	4	0	0	4	5	10	15	70	100	
3	DEC 1	MS BT3 03A	Bioprocess Engineering	4	0	0	4	5	10	15	70	100	
4	DEC 2	MS BT3 03B	Environmental Biotechnology	4	0	0	4	5	10	15	70	100	
5	Practical V (Based on CC 9 & 10)	MS BT3 05P	Plant and Animal Biotechnology Lab	0	0	4	4	5	10	15	70	100	
6	Practical VI (Based on DEC 1 & 2)	MS BT-306 P	Environmental Biotechnology and Bioprocess engineering Lab	0	0	4	4	5	10	15	70	100	
7	OEC 1	MS BT-307 OEC		2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - M.Sc Biotechnology													
SEM:IV													
Batch:2025-26			SEM:IV										
S. No	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment quiz/PPT/Assignment (10)	Mid Sem Test (15)	External Assessment End Sem Exam (70)	Total	Remark
				L	T	P							
THEORY and PRACTICAL SUBJECTS													
1	Core Course 11	MS BT-401	Nanobiotechnology	4	1	0	4	5	10	15	70	100	
2	DEC 5	MS BT-402 A	Genomics and Proteomics	4	1	0	4	5	10	15	70	100	
3	DEC 6	MS BT-403 B	Transcriptomics and Metabolomics	4	1	0	4	5	10	15	70	100	
5	EEC 1			4	1	0	2	5	10	15	70	100	
6	Project Work	MS BT-404 DS		0	0	4	12	0	0	0	250	250	
TOTAL CREDITS / ASSESSMENT							26	20	40	60	530	650	

SYLLABUS

Programme/Class: Certificate		Year: Second (II)	Semester: Third (III)
Subject: Biotechnology			
Course Code: MSBT-301		Course Title: Plant Biotechnology	
Course Outcomes (COs)			
After completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the fundamental concepts and techniques used in plant biotechnology. • Apply biotechnological methods for plant improvement, propagation, and conservation. • Demonstrate knowledge of gene transfer techniques and genetic engineering in plants. • Analyze molecular tools and bioinformatics applications in plant genomics. • Examine ethical, environmental, and regulatory issues in plant biotechnology. 			
Credits: 4		Core Compulsory	
Maximum Marks: 100		Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials- 4			
Unit	Topics	No. of Lectures	
I	Fundamentals of Plant Biotechnology <ul style="list-style-type: none"> • Introduction and scope of plant biotechnology • Plant cell and tissue culture: Totipotency, callus, suspension cultures • Media composition (MS medium), growth regulators • Applications of micropropagation and somatic embryogenesis • 	10	
II	Genetic Engineering in Plants <ul style="list-style-type: none"> • Gene cloning techniques: restriction enzymes, vectors (Ti plasmid, binary vectors) • Gene transfer methods: Agrobacterium-mediated transformation, particle bombardment • Marker genes and selectable markers • Development of transgenic plants (Bt cotton, Golden rice, etc.) 	12	
III	Genomics and Molecular Markers <ul style="list-style-type: none"> • Plant genome organization and gene structure • DNA markers: RAPD, RFLP, AFLP, SSR, SNP • Marker-assisted selection (MAS) and QTL mapping • Functional genomics and transcriptomics in plants 	10	
IV	Plant-Microbe Interactions and Stress Biotechnology <ul style="list-style-type: none"> • Plant response to biotic and abiotic stresses • Role of biotechnology in improving stress tolerance • Biofertilizers and biopesticides: Rhizobium, Azospirillum, Trichoderma • Plant-pathogen interactions and engineered resistance 	12	
V	Applications, Ethics and Regulations <ul style="list-style-type: none"> • Biotechnology in agriculture: GM crops, biofortification, phytoremediation • In vitro conservation and cryopreservation of germplasm 	11	

	<ul style="list-style-type: none"> • Intellectual property rights (IPR) in plant biotechnology • Biosafety guidelines and regulatory frameworks (NBA, Cartagena Protocol) 	
Suggested Reading Books		
<input type="checkbox"/> Bhojwani, S.S. & Razdan, M.K. (2004). <i>Plant Tissue Culture: Theory and Practice</i> . Elsevier.		
<input type="checkbox"/> Chawla, H.S. (2010). <i>Introduction to Plant Biotechnology</i> . Oxford & IBH.		
<input type="checkbox"/> Slater, A., Scott, N. & Fowler, M. (2008). <i>Plant Biotechnology: The Genetic Manipulation of Plants</i> . Oxford University Press.		
<input type="checkbox"/> Kumar, H.D. (2021). <i>A Textbook of Biotechnology</i> . Eastern Economy Edition.		
<input type="checkbox"/> Heldt, H.W. & Piechulla, B. (2021). <i>Plant Biochemistry</i> . Academic Press.		
Practicals:		
<input type="checkbox"/> Preparation and sterilization of MS medium		
<input type="checkbox"/> Aseptic culture of explants (leaf, stem, root)		
<input type="checkbox"/> Callus induction and subculturing		
<input type="checkbox"/> Agrobacterium-mediated transformation in model plant (demo or virtual)		
<input type="checkbox"/> DNA extraction from plant tissue and agarose gel electrophoresis		
<input type="checkbox"/> RAPD or ISSR marker analysis (demo or virtual)		
<input type="checkbox"/> Study of micropropagation stages under the microscope		
<input type="checkbox"/> Study of transgenic crops and biosafety labeling (case study)		

Programme/Class: Certificate	Year: Second (II)	Semester: Third (III)
Subject: Biotechnology		
Course Code: MSBT-302	Course Title: Animal Biotechnology	
Course Outcomes (COs)		
After successful completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the molecular and cellular technologies applied in animal biotechnology. • Analyze the principles and techniques of animal tissue culture and genetic manipulation. • Explain applications of biotechnology in animal health, reproduction, and productivity. • Evaluate ethical, regulatory, and biosafety issues related to animal biotechnology. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials- 4		
Unit	Topics	NO. of Lectures
I	Animal Cell Culture <ul style="list-style-type: none"> • Introduction to animal biotechnology and historical perspectives • Basics of animal cell and tissue culture • Culture media: natural vs synthetic, serum vs serum-free • Primary culture, cell lines, and immortalization • Growth kinetics and cell viability assays • Contamination and cryopreservation 	10

II	Molecular Tools in Animal Biotechnology <ul style="list-style-type: none"> • Recombinant DNA technology and its role in animal systems • Gene cloning and expression in mammalian cells • Vectors for animal cell transformation: viral (retroviral, adenoviral) and non-viral • PCR, RT-PCR, qPCR and applications • DNA sequencing and gene editing tools (CRISPR-Cas9) 	12
III	Transgenic and Cloned Animals <ul style="list-style-type: none"> • Transgenic animals: methods of production (microinjection, viral vectors, gene editing) • Applications of transgenic animals in agriculture and medicine • Animal cloning: somatic cell nuclear transfer (SCNT), Dolly the sheep case study • Ethical and biosafety issues in transgenics and cloning 	10
IV	Reproductive Biotechnology <ul style="list-style-type: none"> • Artificial insemination and embryo transfer technology (ETT) • In vitro fertilization (IVF) and embryo culture • Cryopreservation of gametes and embryos • Hormonal regulation of reproduction • Assisted reproductive technologies (ART) in livestock improvement 	12
V	Animal Health and Biopharmaceuticals <ul style="list-style-type: none"> • Diagnosis of animal diseases using ELISA, PCR, and biosensors • Development of veterinary vaccines and therapeutics • Monoclonal antibodies and therapeutic proteins from animal cells • Production of biopharmaceuticals in transgenic animals (bioreactors) • Emerging technologies: xenotransplantation, stem cell therapy 	11

Suggested Reading Books

- Glick, B.R. & Pasternak, J.J. (2010). *Molecular Biotechnology*. ASM Press.
- Freshney, R.I. (2015). *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. Wiley-Blackwell.
- Brown, T.A. (2016). *Gene Cloning and DNA Analysis*. Wiley.
- Singh, B.D. (2020). *Biotechnology: Expanding Horizons*. Kalyani Publishers.
- Watson, J.D. et al. (2017). *Recombinant DNA: Genes and Genomes – A Short Course*. Freeman.
- Gupta, P.K. (2017). *Elements of Biotechnology*. Rastogi Publications.



Practicals:

- Introduction to animal cell culture lab practices and sterile techniques
- Preparation of culture media and sub-culturing of mammalian cell lines
- Viability testing using Trypan Blue exclusion assay
- Genomic DNA isolation from animal tissue and agarose gel electrophoresis
- PCR amplification of target genes
- ELISA for disease diagnosis
- Microscopic study of cell morphology (normal vs transformed cells)
- Protein expression analysis using SDS-PAGE (optional advanced practical)

Programme/Class: Certificate	Year: Second (II)	Semester: Third (III)
Subject: Biotechnology		
Course Code: MSBT-303A	Course Title: Bioprocess Engineering	
Course Outcomes (COs)		
After successful completion of this course, the students will be able to:		
<ol style="list-style-type: none"> 1. Understand the principles and components of bioprocess engineering and bioreactor design. 2. Explain the kinetics of microbial growth, product formation, and substrate utilization. 3. Analyze the operation and control of bioreactors in upstream and downstream processes. 4. Apply the concepts of sterilization, aeration, agitation, and scale-up in industrial biotechnology. 5. Understand the integration of biochemical engineering concepts with product recovery and purification. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials- 4		
Unit	Topics	N0. of Lectures
I	Introduction to Bioprocess Engineering <ul style="list-style-type: none"> • Scope and applications of bioprocess engineering in industry • Comparison of chemical and biochemical processes • Basic components of bioprocess: upstream, bioreaction, downstream • Overview of microbial growth phases and metabolism 	10
II	Kinetics of Microbial Growth and Product Formation <ul style="list-style-type: none"> • Batch, fed-batch, and continuous cultures • Monod equation, growth-associated and non-growth-associated product formation • Substrate utilization kinetics • Concept of yield coefficients and productivity 	12

III	Bioreactors and Fermentation Technology <ul style="list-style-type: none"> • Types of bioreactors: stirred tank, airlift, bubble column, packed bed • Bioreactor components and design considerations • Aeration and agitation: oxygen transfer (kLa), shear stress • Control parameters: pH, temperature, DO, foam control 	10
IV	Sterilization and Process Monitoring <ul style="list-style-type: none"> • Principles and kinetics of sterilization • Batch and continuous sterilization of media and air • Sensors and control systems in bioprocesses (temperature, pH, DO, pressure) • Automation and data logging in bioprocesses 	12
V	Downstream Processing and Bioprocess Scale-up <ul style="list-style-type: none"> • Cell disruption methods (mechanical, chemical, enzymatic) • Separation techniques: centrifugation, filtration, precipitation • Purification techniques: chromatography, electrophoresis • Scale-up principles and challenges in bioprocess engineering 	11
Suggested Reading Books <ul style="list-style-type: none"> □ Shuler, M.L., &Kargi, F. (2017). <i>Bioprocess Engineering: Basic Concepts</i>. Prentice Hall. □ Doran, P.M. (2013). <i>Bioprocess Engineering Principles</i>. Academic Press. □ Stanbury, P.F., Whitaker, A., & Hall, S.J. (2016). <i>Principles of Fermentation Technology</i>. Elsevier. □ Bailey, J.E., &Ollis, D.F. (2010). <i>Biochemical Engineering Fundamentals</i>. McGraw Hill. □ Rao, D.G. (2010). <i>Introduction to Biochemical Engineering</i>. Tata McGraw Hill. 		
Practicals: <ul style="list-style-type: none"> □ Growth kinetics study using a model microorganism (e.g., <i>E. coli</i>) □ Batch fermentation for enzyme or alcohol production □ Determination of oxygen transfer rate (kLa) using dynamic gassing method □ Media sterilization by autoclaving and filtration □ Downstream processing: centrifugation and protein precipitation □ Purification using ion exchange or affinity chromatography 		



Programme/Class: Certificate	Year: Second (II)	Semester: Third (III)
Subject: Biotechnology		
Course Code: MSBT-303B	Course Title: Environmental Biotechnology	
Course Outcomes (COs)		
After completion of this course, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the biological processes involved in the degradation of environmental pollutants. 2. Demonstrate knowledge of microbial roles in waste treatment and bioremediation. 3. Apply molecular and biotechnological tools in monitoring and restoring ecosystems. 4. Evaluate the environmental applications of genetically modified organisms. 5. Analyze and interpret methods for solid waste management and bioenergy production. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials- 4		
Unit	Topics	N0. of Lectures
I	<ul style="list-style-type: none"> • Introduction to Environmental Biotechnology <ul style="list-style-type: none"> • Definition, scope, and importance • Environmental pollution: types and sources • Role of biotechnology in environmental protection • Microbial diversity in extreme environments 	10
II	<ul style="list-style-type: none"> • Bioremediation and Microbial Degradation <ul style="list-style-type: none"> • Principles of bioremediation (in situ and ex situ) • Biodegradation of hydrocarbons, pesticides, and heavy metals • Biosurfactants and their role in bioremediation • Genetically modified microbes for bioremediation 	12
III	<ul style="list-style-type: none"> • Wastewater and Solid Waste Treatment <ul style="list-style-type: none"> • Wastewater treatment: primary, secondary, tertiary processes • Activated sludge and trickling filter processes • Anaerobic digestion, methanogenesis, and composting • Industrial and hospital effluent treatment 	10
IV	<ul style="list-style-type: none"> • Bioenergy and Environmental Monitoring <ul style="list-style-type: none"> • Biofuels: biogas, bioethanol, biodiesel • Microbial fuel cells (MFCs) and biosensors • Monitoring of environmental pollutants: chemical and biological methods • Biosafety and bioethics in environmental biotechnology 	12

V	<ul style="list-style-type: none"> • Recent Trends and Case Studies <ul style="list-style-type: none"> • Phytoremediation, mycoremediation • Plastic biodegradation and microbial consortia • Nanobiotechnology for environmental cleanup • Case studies: Ganga Action Plan, Oil spill cleanups, E-waste management 	11
<p>Suggested Reading Books</p> <p><input type="checkbox"/> Rittmann, B.E., & McCarty, P.L. (2020). <i>Environmental Biotechnology: Principles and Applications</i>. McGraw-Hill Education.</p> <p><input type="checkbox"/> Evans, G.M., & Furlong, J.C. (2011). <i>Environmental Biotechnology: Theory and Application</i>. Wiley-Blackwell.</p> <p><input type="checkbox"/> Mitra, A. (2021). <i>Environmental Biotechnology</i>. CRC Press.</p> <p><input type="checkbox"/> Rao, M.N., & Dutta, A.K. (2017). <i>Wastewater Treatment and Environmental Biotechnology</i>. Oxford University Press.</p> <p><input type="checkbox"/> Jogdand, S.N. (2014). <i>Environmental Biotechnology</i>. Himalaya Publishing House.</p>		
<p>Practicals:</p> <p><input type="checkbox"/> Isolation of bacteria from contaminated soil/water samples</p> <p><input type="checkbox"/> Biodegradation assay using microbes (e.g., starch, plastic, dyes)</p> <p><input type="checkbox"/> Estimation of Biochemical Oxygen Demand (BOD)</p> <p><input type="checkbox"/> Estimation of Chemical Oxygen Demand (COD)</p> <p><input type="checkbox"/> Effect of pollutants on seed germination/plant growth</p> <p><input type="checkbox"/> Biofertilizer production and quality assessment</p> <p><input type="checkbox"/> Preparation of compost/vermicompost in laboratory conditions</p> <p><input type="checkbox"/> Demonstration of biogas production setup (model-based)</p>		

Programme/Class: Certificate	Year: Second (II)	Semester: Fourth (IV)
Subject: Biochemistry		
Course Code: MSBT-401	Course Title: Nanobiotechnology	
Course Outcomes (COs)		
<p>This course provides foundational and applied knowledge of nanotechnology in biological systems. After completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • Understand the fundamentals and scope of nanobiotechnology. • Learn about the synthesis and characterization of nanomaterials. • Analyze the interaction of nanomaterials with biological systems. • Explore biomedical, pharmaceutical, and environmental applications of nanobiotechnology. • Evaluate the ethical, regulatory, and safety issues related to nanobiomaterials 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	

Total Number of Lectures-Tutorials- 4		
Unit	Topics	N0. of Lectures
I	Introduction to Nanobiotechnology <ul style="list-style-type: none"> • Definition, history and scope of nanobiotechnology. Types of nanomaterials (nanotubes, nanowires, quantum dots, nanoparticles). • Unique properties of nanomaterials and size-dependent effects. Overview of bottom-up and top-down approaches. 	10
II	Synthesis and Characterization of Nanomaterials <ul style="list-style-type: none"> • Biological synthesis of nanoparticles using microbes, plants, and enzymes. • Chemical and physical methods of synthesis. Techniques for characterization: UV-Vis spectroscopy, SEM, TEM, AFM, DLS, XRD, FTIR. 	12
III	Nanomaterials and Biological Systems <ul style="list-style-type: none"> • Nanoparticle-cell interactions, nanotoxicity and biodistribution. • Protein and DNA-based nanostructures. Targeted drug delivery systems. • Biosensors and molecular imaging using nanodevices. 	10
IV	Applications of Nanobiotechnology <ul style="list-style-type: none"> • Nanotechnology in medicine: drug delivery, cancer therapy, diagnostics, tissue engineering. • Nanobiosensors for disease detection. Environmental applications: nanofiltration, pollutant degradation, agricultural nanotech. 	12
V	Ethical, Safety and Regulatory Aspects <ul style="list-style-type: none"> • Health and environmental risks of nanoparticles. Risk assessment protocols. • Ethical and social implications of nanobiotechnology. • Regulatory frameworks: FDA, EPA, ISO standards in nanomedicine. 	11
Suggested Reading Books <ul style="list-style-type: none"> • Guyton and Hall Textbook of Medical Physiology – John E. Hall • Human Physiology – C.C. Chatterjee • Human Physiology: From Cells to Systems – Lauralee Sherwood • Principles of Animal Physiology – Christopher D. Moyes, Patricia M. Schulte • Essentials of Animal Physiology – S.C. Rastogi • Animal Physiology – Richard W. Hill, Gordon A. Wyse, Margaret Anderson 		
Practicals: <ol style="list-style-type: none"> 1. Green Synthesis of Silver Nanoparticles Using Plant Extracts 2. UV-Vis Spectrophotometric Characterization of Synthesized Nanoparticles 3. Agar Well Diffusion Method to Evaluate Antibacterial Activity of Nanoparticles 4. Size and Shape Analysis of Nanoparticles Using Dynamic Light Scattering (DLS) or Microscopy (Demo/Virtual) 5. Preparation of Nanoparticle-Based Drug Delivery System (e.g., Loading of Model Drug 		

like Curcumin)

6. Biosensor Demonstration Using Nanomaterials (e.g., Glucose Sensor Simulation)

Programme/Class: Certificate		Year: Second (II)	Semester: Fourth (IV)
Subject: Biotechnology			
Course Code: MSBT-402A		Course Title: Genomics and Proteomics	
Course Outcomes (COs)			
After successful completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the structure, organization, and functions of genomes in prokaryotes and eukaryotes. • Explain modern genome sequencing, annotation, and analysis techniques. • Interpret principles and applications of transcriptomics and proteomics. • Apply knowledge of protein separation, identification, and characterization techniques. • Understand the tools and databases used in genomic and proteomic analysis. 			
Credits: 4		Core Compulsory	
Maximum Marks: 100		Minimum Passing Marks: As per University norms	
Total Number of Lectures- 4			
Unit	Topics	No. of Lectures	
I	Introduction to Genomics <ul style="list-style-type: none"> • Overview of genomics and its scope • Genome structure and organization in prokaryotes and eukaryotes • Types of genomes: nuclear, mitochondrial, chloroplast • Comparative genomics and model organisms • Gene structure, operons, and regulatory elements 	10	
II	Genome Sequencing and Analysis <ul style="list-style-type: none"> • Genome mapping and sequencing strategies (Sanger, Next-Gen Sequencing) • Shotgun and clone-by-clone sequencing approaches • Genome assembly and annotation • Functional genomics: gene prediction and expression profiling • Applications: human genome project, microbial genomics, personalized medicine 	12	
III	Transcriptomics and Gene Expression Analysis <ul style="list-style-type: none"> • Central Dogma and gene expression regulation • mRNA isolation and quantification (RT-PCR, qPCR) • DNA microarrays and RNA-seq • Transcriptome analysis tools • Small RNAs: miRNA, siRNA and their roles 	10	
IV	Proteomics – Concepts and Approaches <ul style="list-style-type: none"> • Introduction to proteomics and its types (structural, functional, expression) • Protein expression systems and protein extraction • 2D-Gel electrophoresis and mass spectrometry (MALDI-TOF, ESI-MS) 	12	

	<ul style="list-style-type: none"> Protein quantification techniques (iTRAQ, SILAC, DIGE) Post-translational modifications 	
V	Protein Structure and Interaction Analysis <ul style="list-style-type: none"> Protein structure determination: X-ray crystallography, NMR, cryo-EM Protein-protein interaction studies: Co-IP, Yeast Two-Hybrid, FRET Bioinformatics tools in proteomics (BLAST, UniProt, PDB, STRING) Proteome databases and data analysis Applications in drug discovery and biomarker development 	11
Suggested Reading Books <ul style="list-style-type: none"> <input type="checkbox"/> Brown, T.A. (2017). <i>Genomes</i> (4th ed.). Garland Science. <input type="checkbox"/> Primrose, S.B. & Twyman, R.M. (2014). <i>Principles of Gene Manipulation and Genomics</i>. Wiley-Blackwell. <input type="checkbox"/> Liebler, D.C. (2001). <i>Introduction to Proteomics: Tools for the New Biology</i>. Humana Press. <input type="checkbox"/> Campbell, A.M. & Heyer, L.J. (2006). <i>Discovering Genomics, Proteomics, and Bioinformatics</i>. Benjamin Cummings. <input type="checkbox"/> Pennington, S.R. & Dunn, M.J. (2001). <i>Proteomics: From Protein Sequence to Function</i>. Springer. 		
Practicals: <ul style="list-style-type: none"> <input type="checkbox"/> Isolation of genomic DNA from bacterial/plant cells <input type="checkbox"/> Agarose gel electrophoresis of DNA <input type="checkbox"/> PCR amplification of a gene <input type="checkbox"/> Protein separation using SDS-PAGE <input type="checkbox"/> Protein quantification using Bradford/Lowry method <input type="checkbox"/> Western blotting technique demonstration <input type="checkbox"/> Database search and annotation using BLAST and UniProt <input type="checkbox"/> 2D gel electrophoresis (demonstration or virtual lab) 		

Programme/Class: Certificate	Year: Second (II)	Semester: Fourth (IV)
Subject: Biotechnology		
Course Code: MSBT-403B	Course Title: Transcriptomics and Metabolomics	
Course Outcomes (COs)		
After completion of this course, students will be able to: <ul style="list-style-type: none"> Understand the principles and techniques used in transcriptomics and metabolomics. Describe gene expression profiling and its applications in biomedical sciences. Analyze metabolic pathways and interpret metabolite data. Apply omics-based approaches to systems biology, diagnostics, and drug discovery. 		
Credits: 4	Core Compulsory	
Maximum Marks: 100	Minimum Passing Marks: As per University norms	
Total Number of Lectures-		
Unit	Topics	N0. of Lectures
I	Introduction to Omics Sciences	10

	<ul style="list-style-type: none"> • Overview of omics technologies: genomics, transcriptomics, proteomics, metabolomics • Central dogma and gene expression regulation • Importance and applications of transcriptomics and metabolomics in modern biology • Concepts of high-throughput data and systems biology 	
II	Transcriptomics: Methods and Applications <ul style="list-style-type: none"> • RNA types and RNA biology • RNA extraction and quality assessment • Microarray and RNA-Seq technologies • Bioinformatics tools for transcriptome data analysis • Applications in gene expression profiling, biomarkers, and disease research 	12
III	Metabolomics: Principles and Techniques <ul style="list-style-type: none"> • Introduction to cellular metabolism and metabolic flux • Classification of metabolites: primary vs. secondary metabolites • Analytical platforms: GC-MS, LC-MS, NMR • Sample preparation and metabolite extraction • Applications in functional genomics and environmental metabolomics 	10
IV	Data Analysis and Interpretation <ul style="list-style-type: none"> • Normalization and data quality control • Statistical analysis: PCA, clustering, pathway enrichment • Integration of transcriptomics and metabolomics data • Databases and tools: KEGG, MetaboAnalyst, GEO, STRIN 	12
V	Applications and Case Studies <ul style="list-style-type: none"> • Disease biomarker discovery • Nutritional and plant metabolomics • Pharmacogenomics and personalized medicine • Toxicogenomics and drug response • Case studies from cancer biology, microbiome, and host-pathogen interactions 	11
Suggested Reading Books <ul style="list-style-type: none"> □ Aderem, A., & Hood, L. (2001). Systems biology: From genomics to life. <i>Science</i>. • Nicholson, J.K., Lindon, J.C., & Holmes, E. (1999). 'Metabonomics': Understanding the metabolic responses. <i>Nature Reviews Drug Discovery</i>. • Ghosh, Z. & Mallick, B. (2014). <i>Transcriptomics: Methods and Applications</i>. Springer. • Patti, G.J., Yanes, O., & Siuzdak, G. (2012). Metabolomics: The apogee of the omics trilogy. <i>Nature Reviews Molecular Cell Biology</i>. • Kell, D.B. (2004). Metabolomics and systems biology in drug discovery. <i>Drug Discovery Today</i>. 		
Practicals: <ul style="list-style-type: none"> □ Isolation and quantification of total RNA from tissue or cell culture □ Qualitative assessment of RNA purity and integrity (e.g., gel electrophoresis, NanoDrop) □ Introduction to transcriptome datasets and online repositories (e.g., NCBI GEO) □ Use of MetaboAnalyst for metabolomics data analysis □ Interpretation of KEGG metabolic pathways □ Case-based computer simulation of RNA-Seq data analysis 		

- Extraction of plant metabolites and TLC profiling
- Western blotting technique demonstration
- Database search and annotation using BLAST and UniProt
- 2D gel electrophoresis (demonstration or virtual lab)

A series of seven handwritten signatures in black ink, arranged horizontally across the bottom of the page. The signatures vary in style, with some being more stylized and others more legible.