



SWAMI VIVEKANAND  
**SUBHARTI**  
UNIVERSITY  
UGC Approved Meerut



## **Ordinance No. :- V-141-B-9**

(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. Biochemistry**

### **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 Biochemistry and Molecular Sciences
- PO2: Build Competence in 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 Awareness, and Responsible Research Practice
- PO7: Enhance Communication, Scientific Writing, and Presentation Skills
- PO8: Encourage Lifelong Learning and Adaptability to Advancing Technologies
- PO9: Strengthen Interdisciplinary Integration for Real-World Biological Problem Solving
- PO10: Foster Holistic Development, Social Responsibility, and Value-Driven Education



## PROGRAM OUTCOME

PSO1: Mastery of Biochemical Concepts and Biological Systems

PSO2: Proficiency in Biochemical and Molecular Techniques

PSO3: Ability to Analyze and Interpret Biochemical Data

PSO4: Scientific Inquiry, Research Aptitude, and Problem-Solving Skills

PSO5: Competence in Advanced and Emerging Technologies

PSO6: Skilled Application of Laboratory Practices and Biosafety Standards

PSO7: Ethical, Legal, and Social Responsibility in Biosciences

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

<b>SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT</b>							
<b>KERAL VERMA SUBHARTI COLLEGE OF SCIENCE</b>							
<b>Department of Life Science</b>							
<b>M.Sc. Biochemistry</b> <b>(Session 2025-26 onwards)</b>							
		<b>I</b>	<b>II</b>	<b>Internship after II Sem</b>	<b>III</b>	<b>IV</b>	<b>Total</b>
1	Core Course	16	16	<b>4</b>	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
	<b>Total</b>	<b>26</b>	<b>26</b>		<b>26</b>	<b>26</b>	<b>108</b>

# EVALUATION SCHEME

## I YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT														
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE														
Department of Life Science														
Course Name -M.Sc. Biochemistry														
Batch:2025-26			SEM:I											
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment				External Assessment	Total	Remark
				L	T	P		CLASS PARTICIPATION	Quiz/PT/Assignment (10)	Mid Sem Test (15)	TOTAL			
THEORY and PRACTICAL SUBJECTS								CLASS PARTICIPATION	Quiz/PT/Assignment (10)	Mid Sem Test (15)	TOTAL	End Sem Exam (70)		
1	CORE COURSE-1	MSBC-101	Advanced Cell and Cancer Biology	4	0	0	4	5	10	15	30	70	100	
2	CORE COURSE-2	MSBC-102	Biomolecules	4	0	0	4	5	10	15	30	70	100	
3	CORE COURSE-3	MSBC-103	Bioenergetics and Metabolism	4	0	0	4	5	10	15	30	70	100	
4	CORE COURSE-4	MSBC-104	Molecular Biology	4	0	0	4	5	10	15	30	70	100	
5	PRACTICAL COURSE-1	MSBC-105 P	Cell Biology and Biomolecules Lab	0	0	4	4	5	10	15	30	70	100	
6	PRACTICAL COURSE-2	MSBC-106	Bioenergetics and Molecular Lab	0	0	4	4	5	10	15	30	70	100	
7	SEMINAR	MSBC-107 S		0	0	4	2	4	4	7	15	35	50	
<b>TOTAL CREDITS / ASSESSMENT</b>							<b>26</b>	34	64	97	195	455	<b>650</b>	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT														
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE														
Department of Life Science														
Course Name -M.Sc. Biochemistry														
Batch:2025-26			SEM:II											
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment				External Assessment	Total	Remark
				L	T	P		CLASS PARTICIPATION	Quiz/PT/Assignment (10)	Mid Sem Test (15)	TO TAL			
<b>THEORY and PRACTICAL SUBJECTS</b>								<b>CLASS PARTICIPATION</b>	<b>Quiz/PT/Assignment (10)</b>	<b>Mid Sem Test (15)</b>	<b>TO TAL</b>	<b>End Sem Exam (70)</b>		
1	CORE COURSE-5	MSB C-201	Immunology	4	0	0	4	5	10	15	30	70	100	
2	CORE COURSE-6	MSB C-202	Enzymology	4	0	0	4	5	10	15	30	70	100	
3	CORE COURSE-7	MSB C-203	Genetic Engineering	4	0	0	4	5	10	15	30	70	100	
4	CORE COURSE-8	MSB C-204	Pharmaceutical Biochemistry	4	0	0	4	5	10	15	30	70	100	
5	PRACTICAL COURSE-3	MSB C-205P	Immunology and Enzymology Lab	0	0	4	4	5	10	15	30	70	100	
6	PRACTICAL COURSE-4	MSB C206P	Genetics Engineering and Pharmaceutical Chemistry Lab	0	0	4	4	5	10	15	30	70	100	
7	CHM	CHM		2	0	0	2	4	4	7	15	35	50	
<b>TOTAL CREDITS / ASSESSMENT</b>							<b>26</b>	34	64	97	195	455	<b>650</b>	

<b>Programme/Class:</b> Certificate	<b>Year:</b> First (1)	<b>Semester:</b> First (I)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-101	<b>Course Title:</b> AdvanceCell and Cancer Biology	
<b>Course Outcomes (COs)</b>		
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:		
<ul style="list-style-type: none"> <li>• Explain structure-function relationships of advanced cellular organelles and transport systems.</li> <li>• Understand cell signaling pathways and their role in normal and pathological states.</li> <li>• Describe cell cycle regulation, checkpoints, and apoptosis mechanisms.</li> <li>• Analyze the genetic and molecular basis of cancer initiation and progression.</li> <li>• Evaluate anti-cancer strategies and interpret experimental cancer models</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
Unit	Topics	NO. of Lectures
<b>I</b>	<b>Advanced Cell Architecture and Dynamics</b> <ul style="list-style-type: none"> <li>• Advanced structure of nucleus and nuclear pore complex.</li> <li>• Endomembrane system and vesicular trafficking.</li> <li>• Cytoskeleton components: microtubules, microfilaments, intermediate filaments, and motor proteins.</li> <li>• Cell polarity and cell migration.</li> </ul>	12
<b>II</b>	<b>Cell Signaling Mechanisms</b> <ul style="list-style-type: none"> <li>• Types of cell signaling: Autocrine, paracrine, endocrine, juxtacrine.</li> <li>• Signal transduction: GPCRs, RTKs, MAPK, PI3K-AKT, Wnt, Notch pathways.</li> <li>• Secondary messengers: cAMP, Ca<sup>2+</sup>, IP<sub>3</sub>.</li> <li>• Pathway integration and cross-regulation</li> </ul>	12
<b>III</b>	<b>Cell Cycle and Apoptosis</b> <ul style="list-style-type: none"> <li>• Molecular control of the cell cycle: cyclins, CDKs, checkpoints.</li> <li>• DNA damage response and repair mechanisms.</li> <li>• Apoptosis: intrinsic and extrinsic pathways, Bcl-2 family, caspases, p53 role.</li> </ul>	12
<b>IV</b>	<b>Cancer Biology Basics</b> <ul style="list-style-type: none"> <li>• Characteristics of cancer cells, hallmarks of cancer.</li> <li>• Oncogenes and tumor suppressor genes (e.g., Ras, Myc, p53, Rb).</li> <li>• Genetic and epigenetic changes in cancer.</li> <li>• Introduction to metastasis, angiogenesis, tumor</li> </ul>	14

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

#### Suggested Reading Books

- Alberts B. et al. (2015). *Molecular Biology of the Cell*. Garland Science.
- Lodish H. et al. (2021). *Molecular Cell Biology*. W.H. Freeman.
- Cooper G.M., Hausman R.E. (2018). *The Cell: A Molecular Approach*. Sinauer Associates.
- Weinberg R.A. (2013). *The Biology of Cancer*. Garland Science.
- Hanahan D., Weinberg R.A. (2011). *Hallmarks of cancer: the next generation*. Cell, 144(5), 646–674.
- Vogelstein B., Kinzler K.W. (2004). *Cancer genes and the pathways they control*. Nature Medicine, 10(8), 789–799.
- Robbins & Cotran (2021). *Pathologic Basis of Disease*. Elsevier.

#### Practicals-

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

<b>Programme/Class:</b> Certificate		<b>Year:</b> First (1)	<b>Semester:</b> First (I)
<b>Subject:</b> Biochemistry			
<b>Course Code:</b> MSBC-102		<b>Course Title:</b> Biomolecules	
<b>Course Outcomes (COs)</b>			
This course introduces the advanced chemical nature, structure, and function of biomolecules involved in life processes. After completion of this course, students will be able to:			
<ul style="list-style-type: none"> <li>• Understand the structural diversity and biological roles of carbohydrates, lipids, proteins, and nucleic acids.</li> <li>• Explain the structure-function relationship of enzymes and coenzymes.</li> <li>• Illustrate the role of biomolecules in metabolism and bioenergetics.</li> <li>• Identify techniques used in the characterization and analysis of biomolecule</li> </ul>			
<b>Credits:</b> 4		<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100		<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>			
<b>Unit</b>	<b>Topics</b>		<b>N0. of Lectures</b>
<b>I</b>	<b>Carbohydrates</b> <ul style="list-style-type: none"> <li>• Classification: Monosaccharides, disaccharides, oligosaccharides, and polysaccharides.</li> </ul>		10

	<ul style="list-style-type: none"> <li>• Structure and function of glucose, fructose, sucrose, starch, glycogen, cellulose.</li> <li>• Glycoproteins and glycolipids.</li> <li>• Sugar derivatives and their biological importance.</li> </ul>	
<b>II</b>	<b>Proteins and Amino Acids</b> <ul style="list-style-type: none"> <li>• Classification and properties of amino acids.</li> <li>• Structure of proteins: primary, secondary, tertiary, and quaternary.</li> <li>• Protein folding and denaturation.</li> <li>• Functional roles of proteins: enzymes, hormones, transporters, structural</li> </ul>	12
<b>III</b>	<b>Lipids and Membrane Structure</b> <ul style="list-style-type: none"> <li>• Classification: fatty acids, triacylglycerols, phospholipids, steroids, waxes.</li> <li>• Biological functions of lipids.</li> <li>• Structure of biological membranes.</li> <li>• Lipoproteins and lipid metabolism basics.</li> </ul>	10
<b>IV</b>	<b>Nucleic Acids</b> <ul style="list-style-type: none"> <li>• Structure and function of DNA and RNA.</li> <li>• Types of RNA and their roles.</li> <li>• Nucleotides and nucleosides.</li> <li>• DNA packaging in prokaryotes and eukaryotes.</li> </ul>	10
<b>V</b>	<b>Enzymes and Coenzymes</b> <ul style="list-style-type: none"> <li>• Classification and nomenclature of enzymes (IUBMB).</li> <li>• Mechanism of enzyme action, active site, specificity.</li> <li>• Factors affecting enzyme activity.</li> <li>• Coenzymes: NAD<sup>+</sup>, FAD, TPP, PLP, CoA.</li> <li>• Enzyme kinetics: Michaelis-Menten, Km and Vmax, enzyme inhibition.</li> </ul>	13

#### Suggested Reading Books

- Lehninger, A.L., Nelson, D.L., & Cox, M.M. (2017). *Principles of Biochemistry*. W.H. Freeman.
- Voet D. & Voet J.G. (2011). *Biochemistry*. John Wiley & Sons.
- Berg, J.M., Tymoczko, J.L., Gatto, G.J. (2019). *Biochemistry*. W.H. Freeman.
- Satyanarayana, U. & Chakrapani, U. (2017). *Biochemistry*. Elsevier.
- Garrett, R.H., & Grisham, C.M. (2016). *Biochemistry*. Cengage Learning.

#### Practicals:

1. Qualitative Tests for Carbohydrates
2. Qualitative Tests for Proteins and Amino Acids
3. Isolation and Quantification of DNA from Plant or Animal Tissue
4. Determination of Protein Concentration by Lowry or Bradford Method
5. Study of Enzyme Activity: Effect of pH and Temperature on Amylase/Catalase
6. Qualitative Tests for Lipids

<b>Programme/Class:</b> Certificate		<b>Year:</b> First (1)	<b>Semester:</b> First (I)
<b>Subject:</b> Biochemistry			
<b>Course Code:</b> MSBC-103		<b>Course Title:</b> Bioenergetics and Metabolism	
<b>Course Outcomes (COs)</b>			
This course focuses on the principles of bioenergetics and the major metabolic pathways of biomolecules. After completion of this course, students will be able to: <ul style="list-style-type: none"> <li>• Understand the laws of thermodynamics as applied to biological systems.</li> <li>• Describe ATP synthesis and energy coupling in metabolic reactions.</li> <li>• Explain the metabolic pathways of carbohydrates, lipids, proteins, and nucleic acids.</li> <li>• Understand regulation and integration of metabolic networks.</li> </ul>			
<b>Credits:</b> 4		<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100		<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>			
Unit	Topics	N0. of Lectures	
<b>I</b>	<b>Bioenergetics Principles</b> <ul style="list-style-type: none"> <li>• Laws of thermodynamics in biology.</li> <li>• Free energy change (<math>\Delta G</math>), equilibrium, and coupling of reactions.</li> <li>• High-energy compounds and role of ATP.</li> <li>• Overview of metabolic reactions: catabolism vs. anabolism.</li> </ul>	10	
<b>II</b>	<b>Carbohydrate Metabolism</b> <ul style="list-style-type: none"> <li>• Glycolysis: Steps, regulation, and energetics.</li> <li>• Gluconeogenesis and its regulation.</li> <li>• Citric Acid Cycle (TCA): Steps, energetics, and regulation.</li> <li>• Pentose phosphate pathway and its significance</li> </ul>	12	
<b>III</b>	<b>Oxidative Phosphorylation</b> <ul style="list-style-type: none"> <li>• Electron Transport Chain (ETC): Complexes and electron flow.</li> <li>• Chemiosmotic theory and ATP synthesis.</li> <li>• Role of mitochondrial membrane and redox carriers.</li> <li>• Inhibitors and uncouplers of oxidative phosphorylation.</li> </ul>	10	
<b>IV</b>	<b>Lipid and Protein Metabolism</b> <ul style="list-style-type: none"> <li>• Beta-oxidation of fatty acids.</li> <li>• Ketogenesis and lipid biosynthesis overview.</li> <li>• Protein degradation and urea cycle.</li> <li>• Glucogenic and ketogenic amino acids.</li> </ul>	12	
<b>V</b>	<b>Integration and Regulation of Metabolism</b> <ul style="list-style-type: none"> <li>• Hormonal regulation: insulin, glucagon, epinephrine.</li> <li>• Interconnection of carbohydrate, lipid, and protein</li> </ul>	11	

	metabolism. <ul style="list-style-type: none"> <li>• Starvation, diabetes mellitus, and metabolic adaptations.</li> <li>• Metabolic profiles of liver, muscle, adipose, and brain.</li> </ul>	
<b>Suggested Reading Books</b> <ul style="list-style-type: none"> <li>• Molecular Biology of the Gene by James D. Watson et al.</li> <li>• Molecular Biology of the Cell by Alberts et al.</li> <li>• Genes XII by Benjamin Lewin</li> <li>• Principles of Gene Manipulation and Genomics by S.B. Primrose and R.M. Twyman</li> <li>• Molecular Cell Biology by Lodish et al.</li> <li>• Gene Cloning and DNA Analysis by T.A. Brown</li> </ul>		
<b>Practicals:</b> <ol style="list-style-type: none"> <li>1. Estimation of Blood Glucose by Glucose Oxidase Method</li> <li>2. Demonstration of Anaerobic Respiration (Fermentation) Using Yeast</li> <li>3. Assay of Enzyme Activity: Sucrase/Amylase Activity from Plant/Saliva Source</li> <li>4. Extraction and Estimation of Total Lipids from Biological Samples (e.g., Egg Yolk/Seeds)</li> <li>5. Detection of Ketone Bodies in Urine (Rothera's Test)</li> <li>6. Estimation of Urea by DiacetylMonoxime Method</li> </ol>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First (1)	<b>Semester:</b> First (I)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-104	<b>Course Title:</b> Molecular Biology	
<b>Course Outcomes (COs)</b>		
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"> <li>• Understand the structure and replication of DNA and RNA.</li> <li>• Describe gene expression, transcription, and translation processes.</li> <li>• Analyze regulation of gene expression in prokaryotes and eukaryotes.</li> <li>• Gain insights into molecular biology techniques like PCR, blotting, and cloning</li> <li>• Understand mutation, DNA repair, and mobile genetic elements.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
<b>Unit</b>	<b>Topics</b>	<b>N0. of Lectures</b>
<b>I</b>	<b>DNA and RNA: Structure and Replication:</b> <ul style="list-style-type: none"> <li>• DNA as genetic material, structure of DNA (A, B, Z forms), supercoiling, structure and types of RNA,</li> </ul>	10

	<ul style="list-style-type: none"> <li>• prokaryotic and eukaryotic DNA replication, enzymes involved, semi-conservative mechanism, replication fork, Okazaki fragments.</li> </ul>	
<b>II</b>	<b>Transcription:</b> <ul style="list-style-type: none"> <li>• Prokaryotic transcription – promoters, RNA polymerase, initiation, elongation and termination,</li> <li>• Eukaryotic transcription – RNA polymerases, transcription factors,</li> <li>• post-transcriptional modifications (capping, splicing, polyadenylation).</li> </ul>	12
<b>III</b>	<b>Translation and Genetic Code:</b> <ul style="list-style-type: none"> <li>• Structure and role of ribosomes, tRNA, genetic code – properties and degeneracy,</li> <li>• prokaryotic and eukaryotic translation – initiation, elongation, termination; post-translational modifications.</li> </ul>	10
<b>IV</b>	<b>Gene Regulation and DNA Repair:</b> <ul style="list-style-type: none"> <li>• Regulation in prokaryotes (lac and trp operons), Eukaryotic gene regulation – transcriptional and post-transcriptional,</li> <li>• epigenetics, types of mutations, DNA damage and repair mechanisms – mismatch repair, excision repair, SOS response.</li> </ul>	12
<b>V</b>	<b>Recombinant DNA Technology and Molecular Techniques:</b> <ul style="list-style-type: none"> <li>• Restriction enzymes, vectors (plasmids, phage, cosmids), gene cloning, PCR, Southern,</li> <li>• Northern and Western blotting, DNA fingerprinting, CRISPR basics,</li> <li>• applications in health and agriculture.</li> </ul>	11

**Suggested Reading Books**

- **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:**

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

<b>Programme/Class:</b> Certificate	<b>Year:</b> First (I)	<b>Semester:</b> Second (II)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-201	<b>Course Title:</b> Immunology	
<b>Course Outcomes (COs)</b>		
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"> <li>• Understand the organization and components of the immune system.</li> <li>• Describe the types and functions of immune responses.</li> <li>• Comprehend antigen-antibody interactions and immune regulation.</li> <li>• Learn about hypersensitivity, autoimmunity, transplantation, and tumor immunity.</li> <li>• Apply basic immunological techniques in laboratory and clinical settings.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
Unit	Topics	NO. of Lectures
<b>I</b>	<b>Basics of Immunology:</b> <ul style="list-style-type: none"> <li>• 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;</li> <li>• Organs of the immune system – primary and secondary lymphoid organs; Cytokines and chemokines</li> </ul>	10
<b>II</b>	<b>Antigens and Antibodies:</b> <ul style="list-style-type: none"> <li>• Antigen – structure, types, properties, and determinants; Immunoglobulins – structure, classes, functions;</li> <li>• Antigen-antibody interactions – precipitation, agglutination, ELISA, RIA, immunodiffusion, immunoelectrophoresis.</li> </ul>	12
<b>III</b>	<b>Humoral and Cell-Mediated Immunity:</b> <ul style="list-style-type: none"> <li>• B-cell maturation and activation, class switching; T-cell maturation and activation,</li> <li>• MHC molecules structure and types, antigen processing and presentation,</li> <li>• Complement system classical, alternative, and lectin pathways.</li> </ul>	10
<b>IV</b>	<b>Hypersensitivity, Autoimmunity, Transplantation &amp; Tumor Immunity:</b> <ul style="list-style-type: none"> <li>• Types I–IV hypersensitivity; Autoimmune diseases – types, examples, mechanisms; Immunosuppression and tolerance;</li> <li>• Transplantation immunology – graft types, rejection, immunosuppressive therapy;</li> <li>• Tumor immunology – immune surveillance and</li> </ul>	12

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

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

	<ul style="list-style-type: none"> <li>Historical perspective and scope of enzymology; properties of enzymes catalytic power, specificity, co-factors and coenzymes; prosthetic groups and metal ions in enzyme activity.</li> </ul>	
<b>II</b>	<b>Mechanism of Enzyme Action</b> <ul style="list-style-type: none"> <li>Fischer's lock and key and Koshland's induced fit hypothesis,</li> <li>types of enzyme specificity, active site structure, transition state stabilization, acid-base catalysis, covalent catalysis,</li> <li>examples of enzymatic mechanisms (e.g., chymotrypsin, lysozyme).</li> </ul>	12
<b>III</b>	<b>Enzyme Kinetics</b> <ul style="list-style-type: none"> <li>Michaelis-Menten kinetics, derivation of the equation, Lineweaver-Burk plot, determination of <math>K_m</math> and <math>V_{max}</math>,</li> <li>significance of kinetic parameters, multi-substrate reactions, enzyme inhibition: competitive, noncompetitive, uncompetitive, irreversible inhibition.</li> </ul>	10
<b>IV</b>	<b>Regulation of Enzyme Activity</b> <ul style="list-style-type: none"> <li>Allosteric enzymes and models (concerted and sequential), covalent modification, feedback inhibition, isoenzymes, ribozymes, zymogen activation;</li> <li>effect of temperature, pH, and substrate concentration.</li> </ul>	12
<b>V</b>	<b>Applications of Enzymes</b> <ul style="list-style-type: none"> <li>Enzymes in clinical diagnostics, immobilized enzymes: methods and applications; industrial enzymes in food, textile,</li> <li>detergent, and pharmaceutical industries; recent advances in enzyme engineering and biosensors.</li> </ul>	11
<b>Suggested Reading Books</b> <ul style="list-style-type: none"> <li>Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Trevor Palmer</li> <li>Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins Nicholas C. Price and Lewis Stevens</li> <li>Principles of Biochemistry Lehninger (David L. Nelson &amp; Michael M. Cox)</li> <li>Biochemistry by Jeremy M. Berg, John L. Tymoczko, Lubert Stryer</li> </ul>		
<b>Practicals:</b> <ol style="list-style-type: none"> <li>Qualitative Test for Enzyme Activity (Amylase on Starch)</li> <li>Quantitative Assay of Enzyme Activity (Amylase/Catalase)</li> <li>Effect of Temperature on Enzyme Activity</li> <li>Effect of pH on Enzyme Activity</li> <li>Detection of Enzyme Activity in Clinical Samples (e.g., Urease, Alkaline Phosphatase)</li> </ol>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First (1)	<b>Semester:</b> Second (II)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-203	<b>Course Title:</b> Genetic Engineering	
<b>Course Outcomes (COs)</b>		
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"> <li>• Understand the tools and techniques involved in genetic manipulation.</li> <li>• Gain knowledge about vectors, cloning, and gene expression systems.</li> <li>• Learn the applications of recombinant DNA technology in various fields.</li> <li>• Understand biosafety guidelines and ethical considerations.</li> <li>• Apply genetic engineering knowledge to research and industry-based innovations.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
Unit	Topics	NO. of Lectures
<b>I</b>	<b>Introduction to Genetic Engineering</b> <ul style="list-style-type: none"> <li>• History, scope and significance of genetic engineering.</li> <li>• Molecular tools in gene manipulation: restriction enzymes, ligases, DNA polymerases, nucleases, reverse transcriptase, topoisomerase.</li> <li>• Agarose gel electrophoresis and DNA purification techniques.</li> </ul>	10
<b>II</b>	<b>Cloning Vectors and Strategies</b> <ul style="list-style-type: none"> <li>• Plasmids, bacteriophages, cosmids,</li> <li>• BACs, YACs as vectors. Features of ideal cloning vectors. DNA ligation strategies.</li> <li>• Competent cells and transformation techniques: chemical and electroporation.</li> </ul>	12
<b>III</b>	<b>Gene Cloning and Expression</b> <ul style="list-style-type: none"> <li>• Construction of recombinant DNA. Screening of recombinant clones (blue-white screening, colony PCR).</li> <li>• Expression vectors: prokaryotic and eukaryotic systems. Fusion proteins and protein purification tags.</li> </ul>	10
<b>IV</b>	<b>Techniques in Genetic Engineering</b> <ul style="list-style-type: none"> <li>• Polymerase Chain Reaction (PCR): types and applications. Southern, Northern, and Western blotting.</li> <li>• DNA sequencing (Sanger and NGS basics). Site-directed mutagenesis and gene silencing (RNAi).</li> </ul>	12
<b>V</b>	<b>Applications and Biosafety</b> <ul style="list-style-type: none"> <li>• Applications in medicine, agriculture, and industry. Transgenic plants and animals.</li> </ul>	11

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

<b>Programme/Class:</b> Certificate	<b>Year:</b> First (1)	<b>Semester:</b> Second (II)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-204	<b>Course Title:</b> Pharmaceutical Biochemistry	
<b>Course Outcomes (COs)</b>		
<p>This course provides an understanding of the biochemical principles relevant to pharmaceutical sciences. After completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Understand drug metabolism, pharmacokinetics, and pharmacodynamics.</li> <li>• Learn the biochemical basis of drug action and resistance.</li> <li>• Explore biochemical mechanisms involved in disease conditions.</li> <li>• Understand the development of therapeutic agents and drug interactions.</li> <li>• Gain insight into molecular targets for drug design.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
<b>Unit</b>	<b>Topics</b>	<b>NO. of Lectures</b>
<b>I</b>	<b>Basic Concepts in Pharmaceutical Biochemistry</b> <ul style="list-style-type: none"> <li>• Introduction to pharmaceutical biochemistry, scope and significance. Basic principles of drug action.</li> <li>• Types of drugs: agonists, antagonists, inhibitors. Classification of drugs based on structure and function.</li> </ul>	10
<b>II</b>	<b>Pharmacokinetics and Pharmacodynamics</b>	12

	<ul style="list-style-type: none"> <li>Absorption, distribution, metabolism, and excretion (ADME) of drugs. Factors affecting drug bioavailability.</li> <li>Drug-receptor interactions. Dose-response relationship. Therapeutic index.</li> </ul>	
<b>III</b>	<b>Drug Metabolism and Biotransformation</b> <ul style="list-style-type: none"> <li>Phase I and Phase II reactions. Role of liver enzymes in drug metabolism. Enzyme induction and inhibition.</li> <li>Cytochrome P450 system. Biochemical mechanisms of drug detoxification.</li> </ul>	10
<b>IV</b>	<b>Biochemical Basis of Diseases and Drug Action</b> <ul style="list-style-type: none"> <li>Biochemical pathways involved in inflammation, cancer, cardiovascular diseases, and infections.</li> <li>Mechanism of action of antibiotics, antivirals, anticancer, and anti-inflammatory drugs. Drug resistance and tolerance.</li> </ul>	12
<b>V</b>	<b>Molecular Targets and Drug Development</b> <ul style="list-style-type: none"> <li>Enzymes, receptors, and nucleic acids as drug targets. Drug discovery and development process.</li> <li>High-throughput screening, rational drug design, and clinical trials. Introduction to pharmacogenomics.</li> </ul>	11

#### Suggested Reading Books

- Biochemistry & Molecular Biology for the Pharmaceutical Sciences – Richard Bowen
- Pharmaceutical Biochemistry – S.P. Bhutani
- Textbook of Pharmaceutical Biochemistry – V. Rama Rao
- Harper's Illustrated Biochemistry – Victor W. Rodwell et al.
- Principles of Biochemistry – Lehninger (David L. Nelson, Michael M. Cox)
- Essentials of Medical Pharmacology – K.D. Tripathi

#### Practicals:

- Estimation of Blood Glucose by Glucose Oxidase-Peroxidase Method
- Estimation of Serum Creatinine (Jaffe's Method)
- Preparation of Standard Curve and Determination of Drug Concentration (e.g., Paracetamol or Aspirin)
- Assay of Liver Enzymes Involved in Drug Metabolism (e.g., ALT, AST)
- Demonstration of Thin Layer Chromatography (TLC) for Separation of Drug Components

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT														
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE														
Department of Life Science														
Course Name -M.Sc. Biochemistry														
Batch:2025-26				SEM:III										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment				External Assessment	Total	Remark
				L	T	P		CLASS PARTICIPATION	Quiz/PPT/Assignment (10)	Mid Sem Test (15)	TO TAL			
THEORY and PRACTICAL SUBJECTS								CLASS PARTICIPATION	Quiz/PPT/Assignment (10)	Mid Sem Test (15)	TO TAL	End Sem Exam (70)	Total	Remark
1	CORE COURSE-9	MS BC-301	Plant Physiology	4	0	0	4	5	10	15	30	70	100	
2	CORE COURSE-10	MS BC-302	Animal Physiology	4	0	0	4	5	10	15	30	70	100	
3	DISCIPLINE ELECTIVE COURSE -1	MS BC-303 A	To Be select from the Group of DEC	4	0	0	4	5	10	15	30	70	100	
4	DISCIPLINE ELECTIVE COURSE -1	MS BC-304 B	To Be select from the Group of DEC	4	0	0	4	5	10	15	30	70	100	
5	PRACTICAL COURSE- 5	MS BC-305 P	Plant and Animal Physiology Lab	0	0	4	4	5	10	15	30	70	100	
6	PRACTICAL COURSE-6	MS BC-306 P		0	0	4	4	5	10	15	30	70	100	
7	OEC	MS BC-307 OEC	To Be selected from the Bucket of Courses	2	0	0	2	4	4	7	15	35	50	
<b>TOTAL CREDITS / ASSESSMENT</b>							<b>26</b>	34	64	97	195	455	<b>650</b>	

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Course Name -M.Sc. Biochemistry														
Batch:2025-26				SEM:IV										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment	Quiz/PT/Assignment (10)	External Assessment	Total	Remark		
				L	T	P						CLASS PARTICIPATION	Mid Sem Test (15)	TOTAL
<b>THEORY AND PRACTICAL SUBJECTS</b>														
1	CORE COURSE-11	MSB C-401	Nanobiotechnology	4	0	0	4	5	10	15	30	70	100	
2	DISCIPLINE ELECTIVE COURSE -3	MSB C-402A	To Be select from the Group of DEC	4	0	0	4	5	10	15	30	70	100	
3	DISCIPLINE ELECTIVE COURSE -4	MSB C-403B	To Be select from the Group of DEC	4	0	0	4	5	10	15	30	70	100	
4	DISSERTATION	MSBS 404DS		4	0	4	12	20	30	50	100	200	300	
5	EEC	MSB C-405EEC	To Be selected from the Bucket of Courses	0	0	0	2	4	4	7	15	35	50	
<b>TOTAL CREDITS / ASSESSMENT</b>							26	39	64	102	205	445	650	

<b>Programme/Class:</b> Certificate	<b>Year:</b> Second (II)	<b>Semester:</b> Third (III)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-301	<b>Course Title:</b> Plant Physiology	
<b>Course Outcomes (COs)</b>		
This course provides comprehensive knowledge of physiological processes in plants. After completion of this course, students will be able to: <ul style="list-style-type: none"> <li>• Understand water relations, nutrient uptake, and transpiration mechanisms.</li> <li>• Explain photosynthesis, respiration, and enzyme activity in plants.</li> <li>• Learn about nitrogen and lipid metabolism in plant systems.</li> <li>• Analyze plant growth and developmental processes including hormonal regulation.</li> <li>• Understand plant responses to internal and external stimuli.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
Unit	Topics	N0. of Lectures
<b>I</b>	<b>Plant–Water Relations and Mineral Nutrition</b> <ul style="list-style-type: none"> <li>• Diffusion and osmosis; water potential and osmotic potential; absorption and ascent of sap.</li> <li>• Transpiration: mechanism, factors affecting it; stomatal movement. Mineral nutrition: essential elements, their roles and deficiency symptoms, methods to study nutrient requirements.</li> </ul>	10
<b>II</b>	<b>Photosynthesis</b> <ul style="list-style-type: none"> <li>• Photosynthetic pigments and light absorption. Light and dark reactions.</li> <li>• C<sub>3</sub>, C<sub>4</sub> and CAM pathways. Photorespiration and glycolate metabolism. Factors affecting photosynthesis.</li> </ul>	12
<b>III</b>	<ul style="list-style-type: none"> <li>• <b>Respiration and Nitrogen Metabolism</b></li> <li>• Glycolysis, TCA cycle, electron transport chain, oxidative phosphorylation. Pentose phosphate pathway. Biological nitrogen fixation, ammonium assimilation, nitrate and nitrite reduction.</li> </ul>	10
<b>IV</b>	<b>Plant Growth and Development</b> <ul style="list-style-type: none"> <li>• Phases of growth, growth curves. Plant hormones: auxins, gibberellins, cytokinins, abscisic acid, ethylene – biosynthesis,</li> <li>• physiological roles, applications. Photoperiodism, vernalization, seed dormancy and germination.</li> </ul>	12
<b>V</b>	<b>Plant Movements and Stress Physiology</b> <ul style="list-style-type: none"> <li>• Tropic and nastic movements. Abiotic stress: drought, salt, temperature – physiological and biochemical responses.</li> <li>• Role of compatible solutes and stress proteins. Oxidative</li> </ul>	11

	stress and antioxidants in plants.	
<b>Suggested Reading Books</b>		
<ul style="list-style-type: none"> <li>• Plant Physiology and Development – Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, Angus Murphy</li> <li>• Plant Physiology Frank B. Salisbury and Cleon W. Ross</li> <li>• Biochemistry and Molecular Biology of Plants Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones</li> <li>• Introduction to Plant Physiology William G. Hopkins and Norman P.A. Hüner</li> <li>• Plant Biochemistry Hans-Walter Heldt and Birgit Piechulla</li> <li>• Plant Hormones: Biosynthesis, Signal Transduction, Action – Peter J. Davies (Editor)</li> </ul>		
<b>Practicals:</b>		
<ol style="list-style-type: none"> <li>1. Demonstration of Osmosis and Plasmolysis in Plant Cells</li> <li>2. Determination of Water Potential by Plasmolytic Method</li> <li>3. Measurement of Transpiration Rate Using a Simple Potometer</li> <li>4. Separation of Photosynthetic Pigments by Paper or Thin Layer Chromatography (TLC)</li> <li>5. Estimation of Total Chlorophyll Content Using Spectrophotometry</li> <li>6. Effect of Abiotic Stress (e.g., Salt or Drought) on Seed Germination or Seedling Growth</li> </ol>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> Second (II)	<b>Semester:</b> Third (III)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-302	<b>Course Title:</b> Animal Physiology	
<b>Course Outcomes (COs)</b>		
<p>This course provides a comprehensive understanding of physiological processes in animals. After completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Understand the physiology of digestion, circulation, and respiration.</li> <li>• Explain the composition and function of blood and muscles.</li> <li>• Learn about osmoregulation, excretion, and thermoregulation.</li> <li>• Understand nervous coordination and endocrine control</li> <li>• Analyze the role of hormones and their mechanisms in animal systems.</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
<b>Unit</b>	<b>Topics</b>	<b>N0. of Lectures</b>
<b>I</b>	<b>Digestive and Respiratory Physiology</b> <ul style="list-style-type: none"> <li>• Digestive glands, composition and function of digestive juices.</li> <li>• Digestion and absorption of carbohydrates, proteins, lipids.</li> </ul>	10

	<ul style="list-style-type: none"> <li>Respiratory system: structure, exchange of gases, transport of oxygen and carbon dioxide, regulation of respiration.</li> </ul>	
<b>II</b>	<b>Circulatory and Blood Physiology</b> <ul style="list-style-type: none"> <li>Composition of blood and plasma proteins, types and functions of blood cells. Blood coagulation,</li> <li>blood groups. Structure and function of the heart, cardiac cycle, ECG, regulation of heartbeat.</li> </ul>	12
<b>III</b>	<b>Muscle Physiology and Excretion</b> <ul style="list-style-type: none"> <li>Types of muscles, mechanism of muscle contraction (sliding filament theory).</li> <li>Osmoregulation and excretion: structure of nephron, urine formation, counter-current mechanism, ornithine cycle.</li> </ul>	10
<b>IV</b>	<b>Nervous Coordination and Sense Organs</b> <ul style="list-style-type: none"> <li>Neuron structure, generation and propagation of nerve impulse, synapse, neurotransmitters.</li> <li>Central and peripheral nervous system. Structure and function of eye and ear. Reflex arc and sensory physiology.</li> </ul>	12
<b>V</b>	<b>Endocrine System and Thermoregulation</b> <ul style="list-style-type: none"> <li>Structure and function of endocrine glands: pituitary, thyroid, adrenal, pancreas, gonads.</li> <li>Mechanism of hormone action (peptide and steroid). Feedback regulation.</li> <li>Thermoregulation in</li> </ul>	11

	homeotherms and poikilotherms.	
<b>Practicals:</b>		
<ol style="list-style-type: none"> <li>1. Study of Permanent Slides of Mammalian Tissues (e.g., Muscle, Nerve, and Glandular Tissues)</li> <li>2. Estimation of Hemoglobin Content in Blood (Sahli's Method or Hemoglobinometer)</li> <li>3. Recording of Human Blood Pressure and Pulse Rate</li> <li>4. Effect of Exercise on Pulse Rate and Breathing Rate</li> <li>5. Measurement of Lung Capacity Using Spirometer (or Demonstration)</li> <li>6. Observation of Urine Properties (Color, pH, Specific Gravity, and Presence of Glucose/Proteins)</li> </ol>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> Second (II)	<b>Semester:</b> Fourth (IV)
<b>Subject:</b> Biochemistry		
<b>Course Code:</b> MSBC-401	<b>Course Title:</b> Nanobiotechnology	
<b>Course Outcomes (COs)</b>		
<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"> <li>• Understand the fundamentals and scope of nanobiotechnology.</li> <li>• Learn about the synthesis and characterization of nanomaterials.</li> <li>• Analyze the interaction of nanomaterials with biological systems.</li> <li>• Explore biomedical, pharmaceutical, and environmental applications of nanobiotechnology.</li> <li>• Evaluate the ethical, regulatory, and safety issues related to nanobiomaterials</li> </ul>		
<b>Credits:</b> 4	<b>Core Compulsory</b>	
<b>Maximum Marks:</b> 100	<b>Minimum Passing Marks:</b> As per University norms	
<b>Total Number of Lectures- 4</b>		
<b>Unit</b>	<b>Topics</b>	<b>N0. of Lectures</b>
<b>I</b>	<b>Introduction to Nanobiotechnology</b> <ul style="list-style-type: none"> <li>• Definition, history and scope of nanobiotechnology. Types of nanomaterials (nanotubes, nanowires, quantum dots, nanoparticles).</li> <li>• Unique properties of nanomaterials and size-dependent effects. Overview of bottom-up and top-down approaches.</li> </ul>	10
<b>II</b>	<b>Synthesis and Characterization of Nanomaterials</b> <ul style="list-style-type: none"> <li>• Biological synthesis of nanoparticles using microbes, plants, and enzymes.</li> <li>• Chemical and physical methods of synthesis. Techniques for characterization: UV-Vis spectroscopy,</li> </ul>	12

	SEM, TEM, AFM, DLS, XRD, FTIR.	
<b>III</b>	<b>Nanomaterials and Biological Systems</b> <ul style="list-style-type: none"> <li>• Nanoparticle-cell interactions, nanotoxicity and biodistribution.</li> <li>• Protein and DNA-based nanostructures. Targeted drug delivery systems.</li> <li>• Biosensors and molecular imaging using nanodevices.</li> </ul>	10
<b>IV</b>	<b>Applications of Nanobiotechnology</b> <ul style="list-style-type: none"> <li>• Nanotechnology in medicine: drug delivery, cancer therapy, diagnostics, tissue engineering.</li> <li>• Nanobiosensors for disease detection. Environmental applications: nanofiltration, pollutant degradation, agricultural nanotech.</li> </ul>	12
<b>V</b>	<b>Ethical, Safety and Regulatory Aspects</b> <ul style="list-style-type: none"> <li>• Health and environmental risks of nanoparticles. Risk assessment protocols.</li> <li>• Ethical and social implications of nanobiotechnology.</li> <li>• Regulatory frameworks: FDA, EPA, ISO standards in nanomedicine.</li> </ul>	11
<b>Suggested Reading Books</b> <ul style="list-style-type: none"> <li>• Guyton and Hall Textbook of Medical Physiology – John E. Hall</li> <li>• Human Physiology – C.C. Chatterjee</li> <li>• Human Physiology: From Cells to Systems – Lauralee Sherwood</li> <li>• Principles of Animal Physiology – Christopher D. Moyes, Patricia M. Schulte</li> <li>• Essentials of Animal Physiology – S.C. Rastogi</li> <li>• Animal Physiology – Richard W. Hill, Gordon A. Wyse, Margaret Anderson</li> </ul>		
<b>Practicals:</b> <ol style="list-style-type: none"> <li>1. Green Synthesis of Silver Nanoparticles Using Plant Extracts</li> <li>2. UV-Vis Spectrophotometric Characterization of Synthesized Nanoparticles</li> <li>3. Agar Well Diffusion Method to Evaluate Antibacterial Activity of Nanoparticles</li> <li>4. Size and Shape Analysis of Nanoparticles Using Dynamic Light Scattering (DLS) or Microscopy (Demo/Virtual)</li> <li>5. Preparation of Nanoparticle-Based Drug Delivery System (e.g., Loading of Model Drug like Curcumin)</li> <li>6. Biosensor Demonstration Using Nanomaterials (e.g., Glucose Sensor Simulation)</li> </ol>		