



Syllabus of 1st Year M.Sc. Biotechnology



UPL University of Sustainable Technology
SRICT- Institute of Science & Research

AY-2025-2026

UPL University of Sustainable Technology, Ankleshwar

SRICT-Institute of Science and Research (SRICT-ISR)

1st Year M.Sc. Biotechnology

SEM	TYPE OF COURSE	COURSE CODE	NAME OF SUBJECT	Credits
1	Major Course	BIM400-4C	Environment Biotechnology	4
	Major Course	BIM401-4C	Biodiversity	4
	Major Course	BIM402-4C	Cell and Tissue Culture Technique	4
	Minor Course	BIE400-4C	Practicals in Biotechnology - V	4
	Core Course	BIO400-4C	On Job Training-I	6
Total Credits				22
2	Major Course	BIM403-4C	Enzyme Technology	4
	Major Course	BIM404-4C	Bioinformatics & Bio-nanotechnology	4
	Major Course	BIM405-4C	Current Trends in rDNA Technology	4
	Minor Course	BIE401-4C	Practicals in Biotechnology - VI	4
	Core Course	BIO401-4C	On Job Training-II	6
Total Credits				22

M.Sc. Biotechnology
M.Sc. Sem. I
Teaching/Exam Scheme

w.e.f.: July-2026

Sr. No.	Course Code	Category of course	Course title	Hour's Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	BIM400-4C	Major Course	Environment Biotechnology	4	-	-	4	4	50	50	-	-	100
2	BIM401-4C	Major Course	Biodiversity	4	-	-	4	4	50	50	-	-	100
3	BIM402-4C	Major Course	Cell and Tissue Culture Technique	4	-	-	4	4	50	50	-	-	100
4	BIE400-4C	Minor Course	Practicals in Biotechnology - V	-	-	8	8	4	50	50	-	-	100
5	BIO400-4C	Core Course	On Job Training-I	-	-	-	-	6	-	-	75	75	150
			Total	12	0	8	20	22	200	200	75	75	550

M.Sc. Biotechnology
Semester-I
Course Code: BIM400-4C
Course Name: Environment Biotechnology

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Biology, Microbiology and Environmental Science. Fundamental understanding of microorganisms and ecosystem concepts.

Rationale: Environmental Biotechnology integrates microbiology, ecology and biotechnology for solving environmental problems through sustainable biological approaches. This course provides foundational understanding of microbial ecology, biogeochemical cycles, soil and aquatic microbiology, bioremediation and environmental monitoring. It introduces students to the role of microorganisms in ecosystem functioning and environmental management, preparing them for advanced studies, research and green technology applications in line with NEP objectives.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION – A		
1	Microbial Ecology & Environmental Diversity Microbial ecology principles, Microbial growth & energetics, Molecular microbial ecology methods, Microbial diversity overview, Microbial habitats & ecosystem concepts, Microbial interactions, Adaptation to environmental factors.	9

2.	Biogeochemical Cycles Carbon cycle & biodegradation, Nitrogen cycle processes, Sulfur & phosphorus cycles, Carbon transformations, Nitrogen transformations Sulfur & phosphorus cycles.	9
3	Soil & Agricultural Microbiology Soil microbial ecology Rhizosphere & plant-microbe interactions, Biofertilizers & agricultural microbiology, Soil microorganisms, Rhizosphere interactions, Mycorrhizae & symbiosis.	12
SECTION – B		
4	Aquatic Microbiology Wastewater microbiology, Drinking water microbiology, Freshwater & marine microbiology, Freshwater & marine microbiology.	9
5	Environmental Biotechnology & Bioremediation Biodegradation mechanisms, Bioremediation strategies, Heavy metals & toxic compounds, Xenobiotic degradation, Microbial adaptation to pollutants.	12
6	Environmental Monitoring & Emerging Trends Indicator organisms & water quality, Risk assessment & environmental health, Molecular tools in environmental monitoring, Microbial indicators of environmental change, Applied microbial ecology.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	15	20	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. R.M. Atlas and R. Bartha. *Microbial Ecology: Fundamentals and Applications*. 4th edition. Benjamin Cummings. 1998.
2. M.J. Pelczar, E.C.S. Chan and N.R. Krieg. *Microbiology*. 5th edition. Tata McGraw Hill. 2008.
3. P.D. Sharma. *Environmental Microbiology*. 2nd edition. Rastogi Publications. 2016.

Reference Books:

1. Environmental Biotechnology: Principles and Applications. McGraw Hill. 2001.
2. Environmental Microbiology. 3rd edition. Academic Press. 2015.
3. Biotechnology: Expanding Horizons. Kalyani Publishers.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain principles of microbial ecology, environmental diversity and microbial adaptations.	15
CO-2	Describe microbial roles in major biogeochemical cycles and ecosystem functioning.	20
CO-3	Understand soil and agricultural microbiology including plant–microbe interactions and biofertilizers.	15
CO-4	Explain microbial diversity and applications in aquatic systems and wastewater microbiology.	15
CO-5	Analyze principles and applications of environmental biotechnology and bioremediation.	20
CO-6	Apply concepts of environmental monitoring, microbial indicators and emerging molecular tools for environmental assessment.	15

M.Sc. Biotechnology
Semester-I
Course Code: BIM401-4C
Course Name: Biodiversity

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Biology at undergraduate level, Understanding of cell biology, genetics, and ecology, Familiarity with basic classification and nomenclature concepts, Elementary knowledge of microorganisms, plants, and animals.

Rationale: Biodiversity forms the foundation of life on Earth and is essential for ecosystem stability, sustainable development, and biotechnological advancements. This course provides a comprehensive understanding of diversity across microorganisms, plants, and animals, integrating classical taxonomy with modern classification approaches. It emphasizes structure, evolution, ecological roles, and economic importance, along with applications in agriculture, medicine, and industry.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION – A		
1	Prokaryotic Taxonomy, Archaea and Proteobacteria Classification and Identification of prokaryotic organisms, Overview of Archaea, Phylum Creanarchaeota, Phylum: Euarcheaeota, Alphaproteobacteria, Betaproteobacteria, Gammaproteobacteri, Deltaproteobacteria, Epsilonproteobacteria.	9
2	Virology Principles of virus structure, Virus replication strategies, Classification of Virus, Emerging viral diseases, Viroids and prions.	9
3	Mycology Classification of fungi, General features of Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes, Structure, reproduction & life cycles of	12

	Aspergillus, Polyporus, Fusarium. Economic importance: secondary metabolites, antibiotics, biocontrol agents.	
SECTION – B		
4	Algal Diversity Principles and modern classification, General characteristics, thallus organization, evolutionary trends. Structure, reproduction & life cycles of Hydrodictyon, Ulva, Padina, Spirulina, Scytonema. Ecological and economic importance of algae as : biofertilizers, biofuel, food, industry, algal blooms.	9
5	Plant Diversity Bryophytes: classification, morphology, life cycles (Marchantiales, Funariales). Pteridophytes: classification, morphology, anatomy, life cycles (Isoetes, Azolla). Gymnosperms: classification, structure and life cycles (Pinus). Angiosperms: Introduction and distinguishing features (flowers, fruits, double fertilization), general morphology and Life cycle.	12
6	Animal Diversity Principles of taxonomy, Rules of nomenclature (ICZN). Diversity of Invertebrates: General characteristics and classification; Major phyla: Protista, Porifera, Cnidaria, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata. Key Concepts: Locomotion in protozoa, Canal system in Porifera, Polymorphism in cnidarians, Metamerism in annelids, Metamorphosis in insects, Torsion in gastropods, Water vascular system in echinoderms. Diversity of Chordates: general features and classification.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	10	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Text Books:

1. Pelczar, M. J., Chan, E. C. S., Krieg, N. R. *Microbiology*. 5th edition. Tata McGraw-Hill. 2004.
2. Prescott, L. M., Harley, J. P., Klein, D. A. *Microbiology*. 10th edition. McGraw-Hill Education. 2017.
3. Alexopoulos, C. J., Mims, C. W., Blackwell, M. *Introductory Mycology*. 4th edition. John Wiley & Sons. 1996.

Reference Books:

1. Bold, H. C., Wynne, M. J. *Introduction to the Algae: Structure and Reproduction*. 2nd edition. Prentice Hall. 1985.
2. Singh, V., Pandey, P. C., Jain, D. K. *A Textbook of Botany*. 4th edition. Rastogi Publications. 2010.
3. Kotpal, R. L. *Modern Textbook of Zoology: Invertebrates*. 10th edition. Rastogi Publications. 2012.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain classification and identification of prokaryotes, including Archaea and Proteobacteria.	15
CO-2	Describe virus structure, replication strategies, and emerging viral diseases.	20
CO-3	Analyze fungal diversity, structure, reproduction, and economic importance.	15
CO-4	Evaluate algal diversity, life cycles, ecological roles, and industrial applications.	15
CO-5	Interpret plant diversity (Bryophytes to Angiosperms) with evolutionary relationships.	20
CO-6	Assess animal diversity, taxonomy principles, and key functional adaptations.	15

M.Sc. Biotechnology
Semester-I
Course Code: BIM402-4C
Course Name: Cell and Tissue Culture Technique
w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Cell Biology, Genetics and Biotechnology. Fundamental understanding of plant and animal cell structure and function.

Rationale: Cell and Tissue Culture Techniques is a core applied biotechnology course introducing in vitro culture systems for plants and animals, regeneration technologies, stem cell biology and medical applications. The course provides theoretical foundations and practical skills in plant tissue culture, animal cell culture, protoplast technology, somatic hybridization and stem cell applications. It supports skill-oriented and research-driven learning under NEP and prepares students for careers in biotechnology, agriculture, pharmaceuticals and regenerative medicine.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION – A		
1	Fundamentals of Plant Tissue Culture Introduction to plant tissue culture technology’ Culture media: composition, preparation, and sterilization techniques, Factors governing <i>in vitro</i> behavior (light, temperature, hormones, nutrients), Aseptic techniques and contamination control, Types of plant tissue culture (callus culture, suspension culture, meristem culture)	9
2	Plant Regeneration and Genetic Variations Somatic embryogenesis and organogenesis, Plant regeneration pathways, Micropropagation: stages, advantages, and applications, Haploid production and	9

	applications in plant breeding, Somaclonal variation and its significance, Secondary metabolite production in plant cultures.	
3	Protoplast Technology and Somatic Hybridization Isolation and culture of protoplasts, Protoplast fusion techniques (chemical and electrical methods), Somatic hybridization and cybrid formation, Applications in crop improvement and genetic engineering, Cryopreservation of plant cells and germ plasm conservation	12
SECTION – B		
4	Animal Cell Culture Techniques Introduction to animal cell and tissue culture, Primary culture and established cell lines, Balanced salt solutions and growth media (serum-based and serum-free media), Sterile techniques and laboratory setup for mammalian cell culture, Tissue and organ culture methods, Scale-up and bioreactors for animal cell culture.	9
5	Stem Cell Biology and Genetic Engineering Biology and classification of stem cells: embryonic, fetal, and adult stem cells, Stem cell differentiation, renewal, and plasticity, Isolation and propagation of embryonic stem cells, Chimeras and transgenic models, Knockout and knock-in mouse technology, Ethical issues in stem cell research	12
6	Medical Applications of Cell Culture and Stem Cells Hematopoietic stem cells and bone marrow transplantation, Types of transplantation: autologous, allogenic, syngeneic, congenic, Cord blood stem cells and their applications, Adoptive cellular immunotherapy, Artificial tissues and organs (skin, liver, pancreas), Clinical applications of stem cell therapy, Treatment of neurodegenerative diseases (Parkinson's, Alzheimer's, spinal cord injury), Apoptosis: mechanism and biological significance	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	10	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate

C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. S. Bhojwani and M.K. Razdan. *Plant Tissue Culture: Theory and Practice*. Revised edition. Elsevier. 2004.
2. M.K. Razdan. *Introduction to Plant Tissue Culture*. 2nd edition. Oxford and IBH Publishing. 2003.
3. R. Ian Freshney. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. 7th edition. Wiley-Blackwell. 2016.

Reference Books:

1. P.K. Gupta. *Cell and Tissue Culture*. Rastogi Publications. 2015.
2. U. Satyanarayana. *Biotechnology*. Books and Allied Pvt. Ltd. 2017.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain principles, methodologies and applications of plant tissue culture techniques.	15
CO-2	Understand plant regeneration pathways, micropropagation and genetic variation in tissue culture systems.	20
CO-3	Describe protoplast technology, somatic hybridization and germplasm conservation approaches.	15
CO-4	Apply principles of animal cell and tissue culture, growth media preparation and bioreactor systems.	15
CO-5	Analyze stem cell biology, transgenic technologies and ethical aspects of stem cell research.	20
CO-6	Evaluate medical and therapeutic applications of cell culture and stem cell technologies.	15

M.Sc. Biotechnology
Semester-I
Course Code: BIE400-4C
Course Name: Practicals in Biotechnology - V

w.e.f.: July-2026

Type of course: Minor Course

Prerequisite: Students enrolling in this practical course should have basic knowledge of Microbiology, Biotechnology and Cell Biology. Fundamental understanding of laboratory safety and aseptic techniques.

Rationale: This practical course is designed to provide hands-on and virtual skill development in environmental biotechnology, microbial diversity and cell and tissue culture techniques. The course integrates laboratory training, simulation-based learning and applied biotechnology approaches as envisioned under NEP. It develops technical competencies in microbial isolation, biodiversity studies, plant tissue culture and animal cell culture while promoting analytical and research skills.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
-	-	8	8	50	50	100

Contents:

Sr. No.	Content	Total Hours
	1. Isolation and enumeration of soil microorganisms. 2. Study of rhizosphere microorganisms. 3. Study of biofertilizer inoculants and their applications. 4. Study of mycorrhizal associations and symbiosis. 5. Virtual microbial ecosystem analysis. 6. Simulation of biogeochemical cycles. 7. Virtual wastewater treatment process study. 8. Observation and identification of cyanobacteria and algae.	120

	<p>9. Study of fungal morphology.</p> <p>10. Isolation and observation of common fungi from natural samples.</p> <p>11. Study of archaeal and bacterial diversity.</p> <p>12. Demonstration of virus morphology using models/electron micrographs.</p> <p>13. Virtual microbial taxonomy and identification exercises.</p> <p>14. Fungal morphology and spore identification.</p> <p>15. Callus induction from explants.</p> <p>16. Demonstration of somatic embryogenesis.</p> <p>17. Isolation and viability testing of protoplasts (demonstration).</p> <p>18. Animal cell culture laboratory setup and sterile handling practices.</p> <p>19. Online demonstration of mammalian cell culture techniques.</p> <p>20. Stem cell differentiation simulation studies.</p>	
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Distribution of Practical Marks:

A Level	B Level	C Level	D Level
10	15	15	10

Legends: A: Conduction of Practical, B: Regular Record Writing, C: Viva-Voce, D: Understanding

Text Book

1. Dubey, R. C., & Maheshwari, D. K. (2016). *Practical Microbiology*. S. Chand Publishing.
2. Patel, R. J. (2021). *Practical Manual of Microbiology and Immunology*. Nirav & Co.
3. R. Ian Freshney. *Culture of Animal Cells*. 7th edition. Wiley. 2016.
4. P. Gunasekaran. *Laboratory Manual in Microbiology*. New Age International. 2012.

Reference Books

1. S.S. Bhojwani and M.K. Razdan. *Plant Tissue Culture: Theory and Practice*. Elsevier. 2004.
2. Ausubel, F. M., Brent, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A., & Struhl, K. (1995–present). *Current Protocols in Molecular Biology and Bioinformatics*. Wiley-Interscience.
3. Owen, J. A., & Punt, J. (2013). *Essential Immunology Laboratory Manual*. Garland Science.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Perform basic microbiological techniques for isolation, observation and enumeration of microorganisms.	20
CO-2	Demonstrate understanding of microbial diversity, taxonomy and ecological interactions through practical exercises.	15
CO-3	Apply principles of environmental biotechnology in biofertilizer, wastewater and biogeochemical studies.	15
CO-4	Develop basic skills in fungal, algal, plant tissue culture and protoplast techniques.	15
CO-5	Demonstrate introductory skills in animal cell culture and stem cell-related laboratory methods.	15
CO-6	Integrate experimental, virtual and simulation-based biotechnology tools for problem solving and research orientation.	20

M.Sc. Biotechnology
Semester-I
Course Code: BIO400-4C
Course Name: On Job Training-I

w.e.f.: July-2026

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) Plan A: Research Project, and (ii) Plan B: on the Job Training. The program coordinator and placement officer shall conduct an orientation session so that the students can take informed decision to choose between the two options.

On Job Training-I

Type of Course: OJT

Prerequisite: Basic Knowledge of microbial processes and operations.

Rationale: To provide students with practical, real-world experience, focusing on work experience, professional activities, or cooperative education, at the end of the course, students will learn about the application of Biotechnology concepts in modern industries. This will also provide the students an opportunity to practically use their biotechnological science-based skills in a life-science industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P		C	CCE Marks	
0	0	180	6	75	75	150

Content:

Sr. No.	Content	Total Hrs.
1	The students shall carry out 01 month internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the University. Upon completion of the internship, students are required to present their work before the expert committee. Students must submit 01 copy of their spiral internship report to the department.	180

M.Sc. Biotechnology
M.Sc. Sem. II
Teaching/Exam Scheme

w.e.f.: July-2026

Sr. No.	Course Code	Category of course	Course title	Hour s Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	BIM403-4C	Major Course	Enzyme Technology	4	-	-	4	4	50	50	-	-	100
2	BIM404-4C	Major Course	Bioinformatics & Bio-nanotechnology	4	-	-	4	4	50	50	-	-	100
3	BIM405-4C	Major Course	Current Trends in rDNA Technology	4	-	-	4	4	50	50	-	-	100
4	BIE401-4C	Minor Course	Practicals in Biotechnology - VI	0	0	8	8	4	50	50	-	-	100
5	BIO401-4C	Core Course	On Job Training-II	-	-	-	-	6	-	-	75	75	150
			Total	12	0	8	20	22	200	200	75	75	550

M.Sc. Biotechnology
Semester-II
Course Code: BIM403-4C
Course Name: Advanced Enzyme Technology

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Biochemistry, Enzymology and Molecular Biology. Understanding of biomolecules, catalytic mechanisms and metabolic pathways. Introductory concepts of enzyme kinetics and protein structure.

Rationale: Advanced Enzyme Technology focuses on the structure, kinetics, engineering and industrial applications of enzymes. The course provides comprehensive knowledge of enzyme-catalyzed reactions, protein engineering, industrial enzyme applications, bioremediation and enzyme-based biosensors. It integrates theoretical principles with emerging technologies and prepares students for research, industrial applications and advanced studies in biotechnology, biochemistry and bioengineering.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION - A		
1	<p>Kinetics of enzyme-catalyzed reactions Enzyme: Structure, Monomeric – Oligomeric and Multisubstrate Reaction. for Monosubstrate Reaction, Models for Bisubstrate Reaction, Kinetics of single substrate enzyme catalyzed reaction : Michaelis-Menten equation, its modification and its significance, Vmax and Km , Lineweaver-Burk plot, Eadie-Hofstee plot, Hanes plot. Enzyme inhibition kinetics: Reversible inhibition, Competitive inhibition, Non- Competitive , Allosteric inhibition, Substrate inhibition, Partial inhibition, Irreversible, Competitive inhibition.</p>	9

2	Protein engineering Enzyme Engineering of industrial enzymes - Rational design methods, Site directed mutagenesis, Chemical modifications and unnatural amino acids, Random methods, Kinetics of multi-substrate enzyme catalyzed reaction: Ping-pong reaction, Random-order reactions, Compulsory order reactions.	9
3	Properties of Enzymes Thermal stability and catalytic efficiency of enzyme, Site directed mutagenesis and enzyme engineering, Structural motifs and enzyme evolution, Protein folding in vitro & in vivo.	12
SECTION – B		
4	Application of enzymes in industry Milling and Baking: Enzyme in Flour, Enzymes in Starch production, Sweetener and syrup production, Starch liquefaction and dextrose. Pectic enzymes in fruit and juice manufacture: Food processing related properties of pectic enzymes. Textiles and laundry detergents: Enzymes in laundry detergents. Pulp and paper: Enzyme application in pulp and paper processes.	9
5	Enzymes and bioremediation Enzymology of n-alkane oxidation, Enzymes engineered for new Reactions- Novel catalysts for organic synthesis, Extremozymes, Synzymes, Artizymes.	12
6	Enzyme-based biosensors Enzymes in clinical diagnosis: primary and secondary serum enzymes, Enzyme markers of Xenobiotic toxicity, Pharmacogenomics related to polymorphism of drug metabolizing enzymes, KEGG (Kyoto Encyclopedia of Genes and Genomes) pathway.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	10	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate

C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Trevor Palmer and Philip Bonner. *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. 2nd edition. Woodhead Publishing. 2007.
2. Nicholas C. Price and Lewis Stevens. *Fundamentals of Enzymology*. 3rd edition. Oxford University Press. 2000.
3. Dixon and Webb. *Enzymes*. 3rd edition. Academic Press. 1979.

Reference Books:

1. Athel Cornish-Bowden. *Fundamentals of Enzyme Kinetics*. 4th edition. Wiley-Blackwell. 2012.
2. U. Satyanarayana. *Biotechnology*. Books and Allied Pvt. Ltd. 2017.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain enzyme structure, catalytic mechanisms and kinetics of enzyme-catalyzed reactions.	15
CO-2	Analyze concepts and methods of protein engineering and kinetics of multisubstrate enzyme reactions.	20
CO-3	Evaluate properties of enzymes including stability, catalytic efficiency and protein engineering strategies.	15
CO-4	Understand industrial applications of enzymes in food, textile and pulp industries.	15
CO-5	Explain applications of enzymes in bioremediation, novel catalysts and engineered enzymes.	20
CO-6	Analyze enzyme-based biosensors, diagnostic enzymes and pharmacogenomic applications.	15

M.Sc. Biotechnology
Semester-II
Course Code: BIM404-4C
Course Name: Bioinformatics & Bio-nanotechnology
w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Molecular Biology, Genetics and Biotechnology. Fundamental understanding of biomolecules, nucleic acids and proteins. Introductory knowledge of computational biology and biological databases

Rationale: Bioinformatics and Bio-Nanotechnology are rapidly advancing interdisciplinary fields integrating biology, computation and nanoscience. This course introduces students to omics technologies, sequence analysis, phylogeny, computational biology and nanobiotechnology. It provides foundational understanding of genome analysis, proteomics, bioinformatics tools, nanomaterials and their biomedical applications, preparing students for research and innovation in modern biotechnology.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION - A		
1	Bioinformatics Omics Revolution in Biology: Next Generation Sequencing Methods, Short-read sequencing (Illumina), Long-read sequencing (Oxford Nanopore Technologies), Genome Assembly and Closing, Genome Annotation and Mapping, RFLPs, SNPs, AFLPs, Applications of NGS in Modern Biology	9
2	Decoding life through omics Proteomics: Interaction, Expression, Functional, Application of Proteomics: In the field of Medical, Pharmaceutical and Plant Biotechnology, Transcriptomics:	9

	RNA level Gene Expression & DNA Micro array Technology, Metagenomics: Contribution, Designing a metagenomics project (sequence based and function based). Metabolomics	
3	Sequence alignments Pairwise Sequence Alignment - Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity, Methods for pairwise sequence alignment : Global and Local, Multiple Sequence Alignment - Exhaustive Algorithms , Heuristic Algorithms.	12
SECTION – B		
4	Phylogeny Methods of Phylogeny: Maximum likelihood, UPGMA, N-J method, Statistical evaluation of obtained phylogenetic tree, Software for phylogenetic analysis: Phylip, Secondary structure prediction and protein modelling.	9
5	Introduction to nano world Understanding of Nano, The Unit Nanometer, Nanoscience, Nanotechnology, Types and properties of Nanomaterials, Nano motors of biological Systems, ATP Synthase: A Nano turbine Physical and Chemical methods for synthesis of nanoparticles. Self-assembly techniques for synthesizing nanoparticles.	12
6	Applications of nanotechnology Application of DNA and protein nanostructures in molecular nanotechnology and Nano electronics, Application of carbon nanotubes in biological systems: Biosensors, Gene delivery using CNT instead of vector, Pollution control by CNT, Nano particles and its amalgamation with drugs for drug delivery: Liposomes.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	10	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. David W. Mount. *Bioinformatics: Sequence and Genome Analysis*. 2nd edition. Cold Spring Harbor Laboratory Press. 2004.
2. Arthur M. Lesk. *Introduction to Bioinformatics*. 5th edition. Oxford University Press. 2019.
3. Rastogi, Mendiratta and Rastogi. *Bioinformatics: Methods and Applications*. 4th edition. PHI Learning. 2013.

Reference Books:

1. T.A. Brown. *Genomes*. 4th edition. Garland Science. 2018.
2. C.M. Niemeyer and C.A. Mirkin. *Nanobiotechnology: Concepts, Applications and Perspectives*. Wiley-VCH. 2004.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain principles and applications of genomics and omics technologies in modern biology.	15
CO-2	Analyze proteomics, transcriptomics, metagenomics and metabolomics approaches.	20
CO-3	Apply sequence alignment tools and methods for comparative sequence analysis.	15
CO-4	Understand phylogenetic analysis, protein structure prediction and bioinformatics software tools.	15
CO-5	Explain fundamentals of nanoscience, nanomaterials and nanoparticle synthesis.	20
CO-6	Evaluate applications of nanotechnology in biosensors, gene delivery and drug delivery systems.	15

M.Sc. Biotechnology
Semester-II
Course Code: BIM405-4C
Course Name: Current Trends in rDNA Technology
w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Cell Biology, Genetics and Biochemistry. Fundamental understanding of DNA, RNA and protein synthesis. Introductory concepts of molecular biology and microbiology.

Rationale: Recombinant DNA technology has revolutionized modern biology and biotechnology by enabling manipulation of genetic material for research, diagnostics, therapeutics and industrial applications. This course provides fundamental and advanced understanding of molecular biology, gene regulation, recombinant DNA tools, gene transfer systems and emerging applications in genomics and bioinformatics. It prepares students for research, innovation and biotechnology careers while incorporating biosafety and ethical dimensions in alignment with NEP.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
SECTION - A		
1	Nucleic acids structure and replication Structure and Properties of Nucleic Acids: DNA structure (double helix, base pairing, antiparallel strands), RNA structure and types, Chromatin Organization, Nucleosome structure, Genes and Genome Organization, DNA Replication: Mechanism and steps (initiation, elongation, termination).	9
2	Transcription & translation Transcription: Mechanism and stages, RNA polymerase and promoter recognition. Translation and Post-Synthesis Modifications: Post-transcriptional (splicing,	9

	capping, polyadenylation) and Post-translational (folding, modification, activation) mechanism.	
3	Gene regulation & mutation Regulation of Gene Expression: Prokaryotic gene regulation, Eukaryotic gene regulation and epigenetics. Regulation of Transcription: Operon model (Arabinose and Tryptophan Operon). Mutations: Definition and types (point, frameshift, chromosomal), Effects of mutations. Mutagenic Agents: Physical mutagens (UV, X-rays), Chemical mutagens. DNA Repair Mechanisms: Direct repair, Excision repair (base and nucleotide), Mismatch repair and SOS repair.	12
SECTION - B		
4	Recombinant DNA technology Tools of recombinant DNA technology (Restriction enzymes, ligases, vectors), Cloning vectors (plasmids, phages, cosmids, BACs), Gene cloning strategies.	9
5	Gene transfer & expression Methods of gene transfer (Transformation, transduction, conjugation), Expression of recombinant proteins, Reporter genes and selection markers.	12
6	Applications in rDNA technology Applications in medicine and industry (insulin, vaccines, hormones), PCR, blotting techniques, DNA sequencing, Genomics, proteomics & bioinformatics (introductory), Biosafety, bioethics and IPR.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	10	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. James D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick. *Molecular Biology of the*

Gene. 6th edition. Benjamin Cummings. 2007.

2. S.B. Primrose and R.M. Twyman. *Principles of Gene Manipulation and Genomics*. 7th edition. Blackwell Publishing. 2006.

3. Bernard R. Glick and Jack J. Pasternak. *Molecular Biotechnology*. 4th edition. ASM Press. 2010.

Reference Books:

1. T.A. Brown. *Gene Cloning and DNA Analysis*. 7th edition. Wiley-Blackwell. 2016.

2. U. Satyanarayana. *Biotechnology*. Books and Allied Pvt. Ltd. 2017.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain fundamental concepts of molecular biology and central dogma.	15
CO-2	Describe mechanisms of DNA replication, transcription, translation and gene expression.	20
CO-3	Analyze gene regulation, mutations and mobile genetic elements.	15
CO-4	Understand tools, vectors and strategies used in recombinant DNA technology.	15
CO-5	Apply knowledge of gene transfer methods and recombinant protein expression.	20
CO-6	Evaluate applications, recent advances, biosafety and ethical aspects of rDNA technology.	15

M.Sc. Biotechnology
Semester-II
Course Code: BIE401-4C
Course Name: Practicals in Biotechnology - VI
w.e.f.: July-2026

Type of course: Minor Course

Prerequisite: Students enrolling in this practical course should have basic knowledge of Biochemistry, Molecular Biology and Biotechnology. Fundamental understanding of enzyme kinetics and bioinformatics tools. Introductory knowledge of recombinant DNA techniques.

Rationale: This practical course is designed to provide advanced hands-on and computational training in enzymology, bioinformatics, bio-nanotechnology and recombinant DNA technology. It integrates laboratory experiments, simulation exercises and computational tools for skill development as envisaged under NEP. The course strengthens analytical, technical and research capabilities relevant to academic, industrial and applied biotechnology.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
-	-	8	8	50	50	100

Contents:

Sr. No.	Content	Total Hours
	1. Determination of enzyme activity and specific activity. 2. Determination of K_m and V_{max} of an enzyme. 3. Verification of Michaelis-Menten kinetics and Lineweaver-Burk plot. 4. Study of enzyme inhibition (competitive/non-competitive). 5. Effect of temperature and pH on enzyme activity. 6. Immobilization of enzymes and assay of immobilized enzymes. 7. Computational analysis of inhibition kinetics. 8. Molecular docking for enzyme-substrate interactions.	120

	<p>9. Sequence alignment using BLAST tools.</p> <p>10 Pairwise and multiple sequence alignment exercises.</p> <p>11. Construction of phylogenetic trees using bioinformatics software.</p> <p>12. Demonstration of protein structure visualization tools.</p> <p>13 Nanoparticle synthesis (demonstration).</p> <p>14. Demonstration of liposome preparation models.</p> <p>15. Isolation of plasmid DNA.</p> <p>16. Restriction digestion of DNA and agarose gel electrophoresis.</p> <p>17. Demonstration of ligation and cloning strategies.</p> <p>18. Bacterial transformation experiment.</p> <p>19. PCR amplification (demonstration/experiment).</p> <p>20 Demonstration of blotting techniques.</p>	
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Distribution of Practical Marks:

A Level	B Level	C Level	D Level
10	15	15	10

Legends: A: Conduction of Practical, B: Regular Record Writing, C: Viva-Voce, D: Understanding

Text Books

1. Rakesh Patel, Practical Microbiology, S. Chand Publishing, 2023.
2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2012). Microbiology: Concepts and Applications. McGraw-Hill Education.
3. David W. Mount. *Bioinformatics: Sequence and Genome Analysis*. 2nd edition. Cold Spring Harbor Laboratory Press. 2004.
4. T.A. Brown. *Gene Cloning and DNA Analysis*. 7th edition. Wiley-Blackwell. 2016.

Reference Books

5. Atlas, R. M. (2010). Handbook of Microbiological Media (4th ed.). CRC Press.
6. Collee, J. G., Fraser, A. G., Marmion, B. P., & Simmons, A. (1996). Mackie & McCartney

Practical Medical Microbiology (14th ed.). Churchill Livingstone.

7. Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology and Biotechnology (5th ed.). New Age International Publishers.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Perform enzyme assays and analyze enzyme kinetics and inhibition patterns.	20
CO-2	Apply principles of enzyme engineering, immobilization and computational enzymology.	15
CO-3	Use bioinformatics tools for sequence analysis, phylogeny and protein structure studies.	15
CO-4	Demonstrate basic concepts and applications of bio-nanotechnology.	15
CO-5	Perform essential recombinant DNA techniques including plasmid isolation, PCR and transformation.	15
CO-6	Integrate laboratory and computational biotechnology tools for problem-solving and research applications.	20

M.Sc. Biotechnology
Semester-II
Course Code: BIO401-4C
Course Name: On Job Training-II

w.e.f.: July-2026

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) Plan A: Research Project, and (ii) Plan B: on the Job Training. The program coordinator and placement officer shall conduct an orientation session so that the students can take informed decision to choose between the two options.

On Job Training-II

Type of Course: OJT

Prerequisite: Basic Knowledge of microbial processes and operations.

Rationale: To provide students with practical, real-world experience, focusing on work experience, professional activities, or cooperative education, at the end of the course, students will learn about the application of Biotechnology concepts in modern industries. This will also provide the students an opportunity to practically use their biotechnological science-based skills in a life-science industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SSE Marks	
0	0	180	6	75	75	150

Content:

Sr. No.	Content	Total Hrs.
1	The students shall carry out 01 month internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the University. Upon completion of the internship, students are required to present their work before the expert committee. Students must submit 01 copy of their spiral internship report to the department.	180