M.Sc. Biotechnology Syllabus

Duration: 2 Years (4 Semesters)

Total Credits (typical): 80–100 credits (including practicals, seminars, and dissertation)

Structure: Core courses + Practical labs + Electives + Research components

Semester 1 (Foundational Advanced Topics)

- Biochemistry & Biomolecules (Advanced metabolism, enzyme kinetics, bioenergetics)
- Cell Biology & Developmental Biology (Cell signaling, organelles, apoptosis, stem cells)
- Microbiology & Microbial Technology (Bacteriology, virology, microbial genetics, industrial microbes)
- Molecular Biology (DNA replication, transcription, translation, gene regulation)
- Genetics & Molecular Genetics (Mendelian & non-Mendelian inheritance, epigenetics)
- Analytical Techniques & Instrumentation (Spectroscopy, chromatography, electrophoresis, centrifugation)
- Laboratory I (Biochemistry & Analytical Techniques Practicals)
- Laboratory II (Microbiology & Molecular Biology Practicals)
- Seminar / Journal Club (Critical analysis of classical papers – non-credit or low credit)

Semester 2 (Core Biotechnological Tools & Applications)

- Immunology & Immunotechnology (Innate & adaptive immunity, monoclonal antibodies, vaccine design)
- Genetic Engineering / Recombinant DNA Technology (Vectors, restriction enzymes, cloning, CRISPR basics)
- Bioinformatics & Computational Biology (Sequence analysis, databases, phylogenetics, structural bioinformatics)
- Genomics & Proteomics (Next-gen sequencing, genome assembly, mass spectrometry, protein interactions)
- Bioprocess Engineering & Technology (Fermentation, bioreactor design, downstream processing)
- Research Methodology & Scientific Communication (Experimental design, biostatistics, paper writing, ethics)

- Intellectual Property Rights, Bioethics & Biosafety
- Laboratory III (Genetic Engineering & Molecular Biology Practicals)
- Laboratory IV (Immunology & Bioinformatics Practicals)
- Elective (one compulsory) – e.g., Microbial Biotechnology, Molecular Virology, Stem Cell Technology, Pharmacogenomics, Molecular Oncology

Semester 3 (Advanced & Applied Biotechnology)

Core Subjects

- Plant Biotechnology (Tissue culture, transgenic plants, molecular farming)
- Animal Biotechnology (Cell culture, transgenics, animal cloning, regenerative medicine)
- Environmental Biotechnology (Bioremediation, waste treatment, biofuels)
- Bioprocess & Industrial Biotechnology (Scale-up, enzyme technology, biopharmaceutical production)

Electives

- Nanobiotechnology
- Marine Biotechnology
- Food Biotechnology
- Medical Biotechnology / Diagnostics
- Synthetic Biology

Components

- Laboratory V (Plant & Animal Biotechnology Practicals)
- Laboratory VI (Bioprocess & Genetic Engineering Advanced Practicals)
- Project Proposal Preparation & Presentation
- Seminar / Journal Club (Emerging technologies)

Semester 4 (Research & Specialization)

Core / Capstone

- Dissertation / Major Project (Full-time research in lab/industry; thesis submission + viva-voce)
- Advanced Topics / Review (Seminar on dissertation or current trends)

Electives

- Bioentrepreneurship & Startup Management
- Regulatory Affairs in Biotechnology
- AI & Machine Learning in Biotechnology

- Clinical Biotechnology / Personalized Medicine

Components

- Dissertation Presentation & Viva-Voce (major credits)
- Industrial Training / Internship (if not completed earlier)
- Comprehensive Viva / Seminar

Common Structure Notes (2025–2026 Trends)

- Core Focus: Strong emphasis on practicals/labs (40–50% of curriculum), hands-on skills in molecular techniques, bioinformatics tools, and bioprocessing.
- Course Types (CBCS/NEP): Core Courses (CC), Discipline Specific Electives (DSE), Skill Enhancement (e.g., Bioinformatics tools), Value-Added (IPR, Ethics, Research Methods).
- Pedagogy: Lectures + extensive lab work + seminars + journal clubs + industry visits + dissertation (often 6–12 months).
- Tools/Software Exposure: BLAST, PyMOL, Clustal, R/Python for bioinformatics, fermenters, PCR/qPCR, flow cytometry basics.
- Career Path: Research scientist, bioprocess engineer, quality control in pharma/biotech, academia, bioinformatics specialist, patent analyst, etc.