

### **Program outcomes for M. Sc. Biotechnology course**

Programme outcome of M. Sc Biotechnology is to produce competent biotechnologist's who can employ and implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society. Students will exhibit contemporary knowledge in Biotechnology and will be eligible for doing jobs in various sectors of pharmaceutical and biotechnological industry.

Biotechnology teaches about biological sciences with engineering technologies that manipulate living organisms and biological systems to produce products that advance healthcare, medicine, agriculture, food, pharmaceuticals and environment control. Biotechnology is a fundamental area of applied science that utilizes living cells and cellular materials to create pharmaceutical, diagnostic, agricultural, environmental, and other products to benefit society.

The Master of Science in Biotechnology is designed to provide specialised scientific learning along with skills training to help students explore various career paths in agriculture, health care, forensics, industrial processing, and environmental management. Students will be provided hands on learning into the functioning of the biotechnology industry. Students will have to undertake an Industry Project in their second year of the programme.

To develop skills for general Biotechnology techniques like DNA isolation, Protein isolation, Electrophoresis, Plant tissue culture techniques, Polymerase chain reaction, Transformation and vast knowledge of Genetic Engineering, Cell biology and Biochemistry .

To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes, acid-base chemistry and bioenergetics.

To acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways.

Understand the concepts of Molecular biology and Molecular Genetics.

To gain knowledge of rDNA technology and Bioinformatics.

Introduction to principle and application of fundamental laboratory equipments related to Biotechnology like electrophoresis, centrifugation, plant tissue culture techniques, ELISA, RIA.

To learn fundamentals of Bioinformatics and Bioprocess technology.

To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

### Course Outcomes of M. Sc. Biotechnology Programme

	Course code	Course name	Credits	Course outcomes
<b>MSc 1<sup>st</sup> Semester</b>				
1.	SOLS/MBT/C 0001	Biochemistry	3	Study of the classification, nomenclature, structure, general properties and functions of Carbohydrates, Lipids, Proteins and Nucleotides and Enzymes. Understanding of carbohydrate, protein, lipid, purine and pyrimidine biosynthesis, metabolism and regulation in the body.
2.	SOLS/MBT/C 0002	Cell Biology & Membrane Biophysics	3	To understand Intracellular Compartmentalization. Their Structure, organization and functions. To learn about the Structure and Functions of plasma membrane. To understand the molecular aspects of Cell Signaling, Protein sorting Cell Cycle and Cell Division Cell Death Pathways. To understand the basics of cancer biology.
3.	SOLS/MBT/C 0003	Molecular Biology & Genetics	3	To understand the concepts of Molecular Biology and Genetics. To study the chemical & physical properties of nucleic acids. Learn experimental evidences for nucleic acid as carrier of genetic information. To understand DNA replication, transcription, translation in Prokaryotes and Eukaryotes. To study the basic features of genetic code. To understand the regulation of gene expression in Prokaryotes and Eukaryotes. To impart knowledge about DNA damage and Repair mechanism. To understand basic principles and exceptions of Mendelian inheritance. To learn the concepts of Linkage, crossing over and recombination. To gain knowledge

				about the organelle inheritance. To make students understand the role of the X and Y chromosomes in determining sex and how they are inherited.
4.	SOLS/MBT/C 0004	Bio-Analytical Techniques	3	To understand the safety measures in laboratory, handling and care of instruments and demonstrate a broad understanding of life science technologies. To demonstrate ability to plan and execute experiments, and analyze and interpret outcomes. Demonstrate understanding of selected Basic Principles & Concepts about biological techniques like microscopy, centrifugation, electrophoresis and basics of radioactivity.
5.	SOLS/BT/C 0005	Laboratory course I	3	To impart practical knowledge and hands on training based on courses SOLS/BT/C 001 and SOLS/BT/C 002.
6.	SOLS/BT/C 0006	Laboratory course II	3	To impart practical knowledge and hands on training based on courses SOLS/BT/C 003 and SOLS/BT/C 004.

#### **MSc 2<sup>nd</sup> Semester**

7.	SOLS/MBT/C 0007	Immunology	3	To introduce the basic concepts of cells and organs of the immune system and immunity. To study the structure and function of antigen and antibodies. Study of rearrangement of Ig genes. To learn about Major Histocompatibility Complex, antigen processing and presentation, complement system and cytokines. To provide knowledge about Humoral and Cell Mediated Immune Response: B- cell and T – cell receptor complex. Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell
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				cytotoxicity (ADCC). To give an overview of hypersensitivity and autoimmunity. Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines. To provide knowledge of antigen-antibody interaction and Immunodiagnostic techniques: RIA, ELISA, Western blotting, Immunoprecipitation, Immunofluorescence.
8.	SOLS/MBT/C 0008	Microbiology & Microbial Genetics	3	Exposure to the historical aspects of Microbiology. To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy). To appreciate the scope and relevance of microbiology. To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods). To learn factors affecting growth of microbes (Physical and chemical agents) To understand the concepts of Microbial Genetics: Gene transfer mechanisms, Transformation (Competence factor, natural and artificial transformation mechanism), Conjugation ( $F^+$ X $F^-$ mating, Hfr, Hfr X $F^-$ ), Transduction (Mechanism of generalized and specialized transduction) and Phage genetics including regulation of lytic and lysogenic cycle.
9.	SOLS/MBT/C 0009	Genetic Engineering & Applications	3	Development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data and construction of DNA and cDNA libraries.

				<p>Development of research aptitude and technical skills to secure a job in genetic engineering labs.</p> <p>Understand genome complexity, genome organization and genome analysis.</p> <p>Learn Whole genome Sequencing, accessing whole genome sequence databases.</p> <p>Learn various methods of gene expression profiling.</p> <p>Learn the procedures involved in RT-PCR, Northern hybridization, microarrays, proteomics etc.,</p> <p>Learn procedures involved in assigning gene functions.</p> <p>Learn bioinformatics tools in genomics research.</p> <p>Learn strategies for gene identification, allele mining, etc.</p>
10.	SOLS/MBT/C 0010	Biostatistics & Bioinformatics	3	<p>To study relation of Life Science with biostatistics. Importance of statistics in biomedical research.</p> <p>To study various aspects of biostats and bioinformatics. To understand the concept of mean, mode, median, range, mean deviation, standard deviation, standard error, skewness &amp; kurtosis, correlation &amp; regression, chi square test, f-test, t-test. To design and conduct computational experiments.</p>
11.	SOLS/BT/C 0011	Laboratory course I	3	<p>To impart practical knowledge and hands on training based on courses SOLS/BT/C 007 and SOLS/BT/C 008.</p>
12.	SOLS/BT/C 0012	Laboratory course II	3	<p>To impart practical knowledge and hands on training based on courses SOLS/BT/C 009 and SOLS/BT/C 010.</p>
<b>MSc 3<sup>rd</sup> Semester</b>				
13.	SOLS/MBT/C 0013	Plant Biotechnology	3	<p>Learn about tools and techniques of recombinant DNA technology and plant transformation methods.</p>

				<p>Learning vectors used for plant transformation, Engineering plants for biotic stress like insect pests and diseases.</p> <p>Engineering plants for abiotic stress. Engineering plants for herbicide tolerance. Engineering plants for shelf life and nutritional quality.</p> <p>Gaining knowledge on biosafety, risk assessment and regulation of transgenic plants in India.</p>
14.	S0LS/MBT/C 0014	IPR, Bioethics, Bio- Entrepreneurship	3	<p>To introduce students to Intellectual Property Rights and Patenting in biology</p> <p>Gain an understanding of the basic concepts of Patents, Trademarks, Copy rights, Geographical indications and Patent data base</p> <p>Understand the historical background, importance and levels of Biosafety at laboratory and industrial scale.</p>
15.	S0LS/MBT/E 0001b	Immunotechnology	3	<p>Account of the structure and function at the molecular and cellular level of the immune defense.</p> <p>Account for polyclonal, monoclonal and humanized antibodies and production of these describe immunization/vaccination, immunological disease and immunotherapy assess health problems with an immunological background</p> <p>Develop approaches for immune intervention;</p> <p>Discuss immunological techniques and their applications in</p>

				<p>biotechnical industry. Cytokine therapy.</p> <p>Evaluate and assess current and evolving concepts in immunological developments including immunotechnology, immunotherapy (cancer and stem cell) and immunoprophylaxis.</p>
16	S0LS/MBT/E 0002c	Enzymology & Enzyme Technology	3	To learn isolation and purification of enzymes and enzyme assay. To understand large scale production of enzymes, immobilization of enzymes. To understand the concept of artificial enzymes and ribozymes. To study the mechanism of action of some important enzymes. To understand mechanism of hormone action, hormone-receptor interaction.
17	S0LS/MBT/C 015	Laboratory Course I	3	To impart practical knowledge, hands on training and demonstration of based on courses S0LS/BT/C 013 and S0LS/BT/C 014.
18	S0LS/BT/E 003	Laboratory Course II	3	To impart practical knowledge, hands on training and demonstration of based on courses S0LS/BT/E 0001b and S0LS/BT/E 0002c.
<b>MSc 4<sup>th</sup> Semester</b>				
19	S0LS/MBT/C 0016	Environmental Biotechnology	3	<p>Explain the importance of microbial diversity and of molecular approaches in environmental microbiology and biotechnology.</p> <p>Describe existing and emerging technologies that are important in the area of environmental biotechnology;</p> <p>Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling.</p>
20	S0LS/MBT/C	Fermentation &	3	Plan a research career or to work

	0017	Bioprocess Technology		in the biotechnology industry with strong foundation about bioreactor design and scale-up. Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems
21	S0LS/MBT/E 0004a	Advanced Bioinformatics	3	<p>Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. Using existing software effectively to extract information from large databases and to use this information in computer modeling.</p> <p>Problem-solving skills, including the ability to develop new algorithms and analysis methods.</p> <p>An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.</p>
23	S0LS/BT/C 0018	Laboratory Course	3	To impart practical knowledge, hands on training and demonstration of based on courses S0LS/BT/C 016 and S0LS/BT/C 017
24	S0LS/MBT/E 0005	Dissertation	6	Gain knowledge to identify the research problem, formulating a research proposal, methodically implementing the research, recording the results through experiments, interpreting the results and deriving a solution for the research problem.



