

M.Sc. Microbiology

Programme Code: 341

Programme Summary

Duration: 2 years

Eligibility

B Sc with CBZ or any other equivalent degree like Biotechnology /Microbiology / Biochemistry /Genetics / Industrial Microbiology / Medical Lab

Technology with minimum 50% marks in aggregate.

Program outcome:

- To develop skills for general microbiological techniques and introduction to bacteriology, virology, mycology, phycology and protozoology .
- 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 microbial genetics.
- To gain knowledge of Microbial physiology and metabolism.
- To learn detail related to immune response and its regulation immune- pathology and transplantations.
- Introduction to principle and application of fundamental laboratory equipments related to microbiological techniques.
- To be trained in recombinant DNA technology.
- To learn fundamentals of Medical microbiology and understand concept of quality control in medical microbiology laboratory.
- To introduce essentials of industrial microbiology and to learn the basic aspects of fermentation and its operational modes.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

Course outcome:

	Course code	Course name	Credits	Course outcome
1st Semester				
1	SLS/MIC/C001	General Microbiology	4	<p>Exposure to the historical aspects of Microbiology.</p> <p>To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy).</p> <p>To appreciate the scope and relevance of microbiology.</p> <p>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).</p> <p>To learn factors affecting growth of microbes (Physical and chemical agents).</p> <p>To get introduced to: Basic bacteriology, general mycology, phycology and protozoology.</p>
2	SLS/MIC/C002	Fundamentals of Biochemistry	4	<p>To understand fundamentals of biochemistry: Acid-base Chemistry and Bioenergetics. including(Energy generation in biological systems: Phosphorylation ,electron transport chain, Electron carriers, Artificial electron donors, Inhibitors and uncouplers of oxidative phosphorylation, Chemiosmotic theory of ATP synthesis).</p> <p>Classification, nomenclature, structure, general properties and functions of Carbohydrates , Lipids ,Proteins and Nucleotides and Enzymes.</p>
3	SLS/MIC/C003	Cell Biology	4	<p>To acquire knowledge of Intracellular Compartmentalization of Cell .Their Structure, organization and functions.</p> <p>To learn about the Architecture of Plasma Membrane and Solute Transport (Fluid mosaic model) Solute transport across membranes: Diffusion (Simple and facilitated), Active transport (Primary and secondary), Pumps and transporters, Ion channels (Ligand gated and voltage gated channels), Trans-epithelial transport, Mechanism of regulation of intracellular transport.</p> <p>To provide knowledge of Cell Signalling Cell Cycle and Cell Division Cell Death Pathways.</p>
4	SLS/MIC/C004	Molecular biology and microbial genetics		<p>To understand the concepts of Molecular biology and microbial genetics.</p> <p>Learn experimental evidences for nucleic acid as carrier of genetic information. DNA replication in prokaryotes and eukaryotes</p> <p>Basic features of genetic code; Translation in prokaryotes and eukaryotes.</p> <p>To impart knowledge of Recombination, Transposition (The Holliday model, Double strand break repair model) and DNA Repair mechanism (Photo reactivation, Methyl directed mismatch repair, Very short - patch mismatch repair, Nucleotide excision repair,</p>

				Base excision repair, SOS system). To understand the concepts of Microbial genetics: Bacterial plasmids Gene transfer mechanisms, Transformation (Competence factor, natural and artificial transformation), Conjugation (F+ X F- mating, Hfr, Hfr X F-, and F', mechanism of conjugation and sexduction), Transduction (Mechanism of generalized and specialized transduction, LFT and HFT lysate) and Phage genetics(lambda and M13 phage)
5	SLS/MIC/C005	Laboratory course 1	3	To impart practical knowledge and hands on training based on courses SLS/MIC/C001 and SLS/MIC/C002.
6	SLS/MIC/C006	Laboratory course 2	3	To impart practical knowledge and hands on training based on courses SLS/MIC/C003 and SLS/MIC/C004.
2nd Semester				
7	SLS/MIC/C007	Microbial physiology and metabolism	4	To learn about Microbial Photosynthesis and Inorganic Metabolism.
				To study in detail Nitrogen fixation :Inorganic nitrogen metabolism, Assimilation of inorganic nitrogen, Regulation of nitrate assimilation and Sulphur metabolism: Free and bound pathways of assimilation of sulphate into cysteine, Glutathione and its role in sulphur metabolism. To learn in detail about microbial respiration and fermentation. To impart knowledge of Bacterial transport system: Donnan equilibrium, Thermodynamics of various transport systems, Osmosis, Plasmolysis, Osmotic pressure of electrolyte and non-electrolyte transport protein, PEP-PTS system in relation to catabolite repression, ABC transporter, Protein secretion pathways in bacteria and bacterial communication mechanisms in prokaryotes (Pheromones mediated signalling and quorum sensing). To explain the Microbial Stress mechanism and its response.

	SLS/MIC/C008	Immunology	4	<p>To introduce the basic concepts of immune system and immunity structure and function of antigen and antibodies.</p> <p>To provide knowledge of antigen antibody responses and Immunodiagnostic techniques: Immuno electrophoresis, RIA, ELISA, Chemiluminescence immunoassay, Western blotting, Complement fixation test, Immunofluorescence, Flow cytometry.</p> <p>To learn about Complement system, Cytokines and Major Histo-compatibility Complex</p> <p>To provide knowledge about Humoral and Cell Mediated Immune Response and Regulation:</p> <p>B- cell and T – cell receptor complex, Positive and negative regulation; Immune Response: T -Cell independent and T- Cell dependent defence mechanisms.</p> <p>Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell cytotoxicity (ADCC), Macrophage-mediated cytotoxicity.</p> <p>To update knowledge in aspect of Immuno pathology and Transplantations including : Rh-blood groupings, Hypersensitivity reactions (Antibody mediated type I, anaphylaxis, type II- antibody dependent cell cytotoxicity, type III-immune complex mediated reactions and type IV-delayed hypersensitivity reactions), Immune surveillance, Self tolerance, Autoimmune diseases, Immunodeficiency; Tumor immunology, Immunotherapy of cancer, Immuno toxins; Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines.</p>
9	SLS/MIC/C009	Biological techniques	4	<p>To learn in detail about Principles and applications of Microscopy, Biosensors, Centrifugation, Chromatography, Electrophoresis, Spectroscopy and Radiotracer techniques.</p>
10	SLS/MIC/C010	Recombinant DNA technology	4	<p>To introduce principles and Tools of Gene Cloning.</p> <p>To learn about the strategies and steps of gene cloning.</p> <p>To be trained in expression of cloned gene in heterologous System(Prokaryotes and Eukaryotes) ,</p> <p>Basic architecture of an expression vector (pEt, pcDNA3 and cytomegalovirus) .Model host systems: <i>E. coli</i>, Fungi, Mammalian cell lines, Insect cells, Transgenic plants and animals.</p> <p>To be able to Identify and study translation product of a cloned gene: HRT and HART techniques.</p> <p>To gain knowledge of sequence detection, amplification and modification techniques. Southern, Northern and Western blotting; Probe labelling and hybridization; DNA sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.</p> <p>To be trained in principle ,methods and applications of : PCR and techniques used in</p>

				genome analysis
11	SLS/MIC/C011	Laboratory course 1	3	To impart practical knowledge and hands on training based on courses SLS/MIC/C007 and SLS/MIC/C008.
12	SLS/MIC/C012	Laboratory course 2	3	To impart practical knowledge and hands on training based on courses SLS/MIC/C009 and SLS/MIC/C010.
3rd Semester				
13	SLS/MIC/C013	Medical microbiology	4	To learn fundamentals of Medical microbiology and quality control in medical microbiology laboratory. To provide knowledge regarding mechanism of pathogenesis(Pathogenicity islands) and antimicrobial chemotherapy. To learn in detail Clinical features , pathogenesis, laboratory diagnosis and preventive measures of : Bacterial diseases (Cholera, Leprosy, Diphtheria, Tetanus, Meningitis, Conjunctivitis, Pneumonia and Gastroenteritis). Viral diseases(Herpes, Chikungunya, Influenza, Measles, Mumps, Hepatitis, HIV, Viral cancer). Protozoal diseases (Amoebiasis, Giardiasis, Leishmaniasis, Malaria) and Fungal diseases (Aspergillosis, Cryptococcosis, Candidiasis, Blastomycosis).
14	SLS/MIC/C014	Industrial microbiology	4	Introduction to different industrial microbiology. To be skilled on the basic aspects of fermentation, Operational modes of fermentation (Batch, fed- batch, continuous) and Downstream processing. To impart knowledge regarding strategies for strain improvement. To be trained in Industrial production of antibiotics, amino acid ,biopolymers ,steroids biotransformation, enzymes ,alcohol ,alcoholic beverages, vitamins ,organic acids ,ergot alkaloids and bio plastics.
15	SLS/MIC/C015	Food and dairy microbiology	4	To learn the principles of food preservation, contamination and spoilage. To be educated regarding food control agencies (FDA, EPA, CDC , ISI) and GMP, HACCP system and food safety act and trade regulations. To deliver knowledge of bacterial and nonbacterial infections and intoxications (<i>Brucella</i> , <i>Bacillus</i> , <i>Clostridium</i> , <i>Escherichia</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Staphylococcus</i> , <i>Vibrio</i> , <i>Yersinia</i> , <i>Listeria</i>), nematodes, protozoa, algae, fungi and viruses. To learn about the structure, functions and Laboratory testing procedures of aflatoxins.
16	SLS/MIC/E02F	Research methodology	4	To develop aptitude for formulating research problem and experimental planning. To learn about data collection and statistical analysis. To be trained in statistical basis of biological assay. To introduce various biological databases (Primary, secondary and composite databases) ,

				biological information system(SRS, ENTREZ). Sequence similarity tools (FASTA ,BLAST).Sequence information sources of nucleotide (GenBank, EMBL, EBI, DBJ ,UCSC)and protein sequence information sources (PIR, ExPASy, UniProt KB, SwissProt and TrEMBL)and Phylogenetic analysis. To develop technical writing skills.
17	SLS/MIC/C015	Laboratory course -I	3	To impart practical knowledge based on theory papers SLS/MIC/E13 and SLS/MIC/E14)
18	SLS/MIC/E003	Laboratory course -II	3	To impart practical knowledge based on theory papers SLS/MIC/C015 and SLS/MIC/E02F
4th Semester				
19	SLS/MIC/E004	Dissertation	10	To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis.