

## **M.Sc. Biochemistry**

**Programme Code: 327**

### **Programme Summary**

Duration: 2 years

### **Eligibility**

B Sc with CBZ or any other equivalent degree like Biotechnology/ Microbiology/ Biochemistry/ Genetics/ Industrial Microbiology/ MLT with minimum 50% marks in aggregate.

### **Program outcomes:**

- To learn chemistry of biomolecules and their biological significance.
- To acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways.
- Understand the basic concepts of animal physiology and its application in clinical Biochemistry.
- To acquire the knowledge of principles of plant Biochemistry and their applications in plant research.
- Introduction to principle and application of fundamental laboratory equipments involved in Biochemical research.
- To learn the concepts of metabolism and its application in prognosis of various diseases.
- To introduce essentials of industrial microbiology and to learn the basic aspects of fermentation and its operational modes.
- To learn basic concepts of nutrition and design of diets in various diseases.
- To learn basic concepts of molecular Biology and its application in various recombinant techniques.
- To learn fundamentals of Clinical Biochemistry and understand its application in diagnostic laboratory.
- To learn detail related to immune response and its regulation immunopathology and transplantations.
- To understand the concepts of Neurobiochemistry and its application in brain research.
- To understand the basics of drug design and application of Biochemistry in drug design.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

**Course outcomes:**

|                                | Course code       | Course name                          | Credits | Course outcomes  |
|--------------------------------|-------------------|--------------------------------------|---------|--|
| <b>1<sup>st</sup> Semester</b> |                   |                                      |         |  |
| I                              | SOLS/Biochem/C001 | Laboratory course 1                  | 3       | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C003 and SOLS/ biochem/C004.  |
| II                             | SOLS/Biochem/C002 | Laboratory course 2                  | 3       | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/C005. And SOLS/ Biochem/C006.   |
| III                            | SOLS/Biochem/C003 | Biomolecules                         | 3       | To understand the structure, properties and classification of carbohydrates, lipids and proteins.<br>To learn the biological significance of major biomolecules.<br>To acquire knowledge of vitamins and its deficiency diseases.<br>To learn basic concepts of enzymes and its role in metabolism.  |
| IV                             | SOLS/Biochem/C004 | Cell Biology & Physiology            | 3       | To acquire knowledge of Intracellular Compartmentalization of Cell .Their Structure, organization and functions.<br>To acquire the knowledge of blood as connective tissue, the classification and of its various cells, transport of gases through the blood.<br>To learn physiology of digestive system and its relation with cellular metabolism.<br>To learn physiology of excretory system and its application in nitrogen metabolism.<br>To understand physiology of alveolar respiration and cellular respiration.<br>To learn basics of endocrine system, its role in controlling metabolism and various endocrinal disorders. |
| V                              | SOLS/Biochem/C005 | Plant Biochemistry                   | 3       | To acquire the knowledge of photosynthesis including role of photosystems, light reaction, cyclic and noncyclic photophosphorylation, C3 and C4 pathway of carbon reduction and photorespiration.<br>To learn basic concepts of nitrate and sulphate assimilation in plants.<br>To understand chemistry, structure and role of secondary plant metabolites.<br>To understand chemistry and biological importance of plant toxins.<br>To understand various types of stress and changes in plant metabolism in response to stress.  |
| VI                             | SOLS/Biochem/C006 | Biochemical & Biophysical Techniques | 3       | To learn the concepts of spectroscopy, interaction of light with matter, classification of spectroscopy, Laws governing spectroscopy and their applications in biochemical research.<br>To learn the concepts and classification of chromatography and its application as purification techniques.<br>To acquire the knowledge of principle, classification of electrophoresis and its application as  |

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|                                |                       |                                    |   | separation technique role of electrophoresis in molecular biology and molecular weight determination of biomolecules.<br>To learn the basics of electron microscopy including Scanning and transmission electron microscopy and specific staining of biological materials.   |
| <b>2<sup>nd</sup> Semester</b> |                       |                                    |   |  |
| VII                            | SOLS/<br>Biochem/C007 | Laboratory course -<br>III         | 3 | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C009 and SOLS/ biochem/C0010.   |
| VIII                           | SOLS/<br>Biochem/C008 | Laboratory course -<br>IV          | 3 | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C011 and SOLS/ biochem/C0012.   |
| XI                             | SOLS/Biochem/<br>C009 | Metabolism I                       | 3 | To understand the basic concepts of bioenergetics including the relation of $\Delta G$ and spontaneity of the reaction, standard free energy change and equilibrium constant, Standard free energy change in coupled reactions, high energy compounds in biology and free energy hydrolysis of ATP.<br>To understand different approaches of studying metabolism.<br>To understand role of coenzymes and cofactors in metabolic pathways and mechanism of their action.<br>To understand carbohydrate metabolism its role in energy production and its regulation.<br>To understand Amino acid metabolism its role in excretion and its regulation.  |
| X                              | SOLS/<br>Biochem/C010 | Metabolism II                      | 3 | To study in detail about fat metabolism and its role in providing energy and development f obesity.<br>To study in detail about nucleic acid metabolism and its integration with over all metabolism.<br>To study in detail Nitrogen fixation: Inorganic nitrogen metabolism, Assimilation of inorganic nitrogen, Regulation of nitrate assimilation.<br>To learn about biosynthesis and role of plant hormones.   |
| XI                             | SOLS/<br>Biochem/C011 | Basic & Industrial<br>microbiology | 3 | Exposure to the historical aspects of Microbiology.<br>To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy).<br>To appreciate the scope and relevance of microbiology.<br>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).<br>To learn factors affecting growth of microbes (Physical and chemical agents).<br>To learn about the basics of virology, mycology and protozoology.<br>Introduction to different industrial microbiology.<br>To be skilled on the basic aspects of fermentation, Operational modes of fermentation (Batch, fed- batch, continuous) and Downstream processing. |

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|                                |                   |                          |   | <p>To impart knowledge regarding strategies for strain improvement.</p> <p>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.</p>   |
| XII                            | SOLS/Biochem/C012 | Nutritional Biochemistry | 3 | <p>To learn about basic concepts of nutrition including BMR, SDA, calculation of energy requirement of individual.</p> <p>To learn about different components of food including fibers and their importance.</p> <p>To study about food additives and their different roles.</p> <p>To study about antinutrients and their importance in food.</p> <p>To learn basic concepts of obesity, its complication, causes and different procedure to reduce obesity and concept of weight reduction diets.</p> <p>To study about the diseases related to malnutrition and their treatment.</p> <p>To study about starvation and concepts of techniques to study starvation and metabolic changes during the starvation.</p> <p>To study the Role of diet &amp; nutrition in the prevention and treatment of diseases.</p> |
| XIII                           | SOLS/Bioem/C013   | Lab Course V             | 3 | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/C014 and SOLS/ Biochem/C015.  |
| XIV                            | SOLS/Biochem/C013 | Lab Course VI            | 3 | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/E001 and SOLS/ Biochem/E002.  |
| <b>3<sup>rd</sup> Semester</b> |                   |                          |   |  |

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| XV   | SOLS/<br>Biochem/C014 | Molecular<br>Biology               | 3 | <p>To understand the concepts of Molecular biology.</p> <p>Learn experimental evidences for nucleic acid as carrier of genetic information.</p> <p>To understand the basics of DNA replication in prokaryotes and eukaryotes.</p> <p>To learn about basics of transcription including reverse transcription and inhibitors of transcription.</p> <p>To learn about Basic features of genetic code.</p> <p>To learn about Translation in prokaryotes and eukaryotes including post translational modification and protein localization.</p>   |
| XVI  | SOLS/Biochem/<br>C015 | ENZYMOLOGY                         | 3 | <p>To learn about basics of enzymes and IUB classification.</p> <p>To study about enzyme purification and isolation using various chromatographic techniques.</p> <p>To study about kinetics of enzymatic reaction including mathematical derivation of Michalis menten equation for unisubstrate reaction basics of bisubstrate reaction.</p> <p>To study about the inhibitors both reversible and irreversible derivation of their Michalis menten equation and their role in metabolism.</p> <p>To learn about control of metabolic reactions using enzyme modulation such as allosterism and covalent modification.</p> <p>Applications of enzymes in various industries.</p> <p>To study about multi enzyme complexes and their role.</p>   |
| XVII | SOLS/<br>Biochem/E001 | Methods in<br>Molecular<br>Biology | 3 | <p>To learn about control of transcription and translation in eukaryotes and prokaryotes.</p> <p>To learn about basics of gene pseudogenes, split genes, super gene family, transposons, C-value paradox. Re-association kinetics.</p> <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), 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 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 genome analysis.</p> <p>To apply RDT production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy.</p> |

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| XVIII                          | SOLS/<br>Biochem/E002 | Clinical<br>Biochemistry | 3 | <p>To study about the disorders of carbohydrate metabolism including diabetes mellitus, its diagnosis, metabolic disorders and treatment related to Diabetes mellitus.</p> <p>To learn about lipid disorders including hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, abetalipoproteinemia.</p> <p>To learn about Inborn Errors of amino acid metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, histidinemia.</p> <p>To study about Liver function tests and their role in differential diagnosis of jaundice.</p> <p>To learn about kidney function tests.</p> <p>To learn basics of diagnostic enzymes and their role in diagnosis of different diseases.</p> <p>To study about different disorders related to clotting.</p> <p>To study about prognosis, diagnosis, prevention and treatment of cancers.</p>                                    |
| <b>4<sup>th</sup> Semester</b> |                       |                          |   |  |
| X                              | SOLS/<br>Biochem/C016 | Neurobiochem<br>istry    | 3 | <p>To study about Classification of muscle fibers and their anatomy, biochemistry of muscle including role of calmodulin.</p> <p>To learn about basics of Neuromorphology including – Organisation of neuron, dendrites and axons. Glial cells – astrocytes, oligodendrocytes, ependymal cells, Schwann cells.</p> <p>To learn about basics of neurophysiology including Generation and conduction of monophasic action potential, salutatory conduction. Synaptic transmission, Neurotransmitters and their action. Blood Brain CSF barrier.</p> <p>To study about transport across the membranes including its role in neurobiochemistry.</p> <p>To study about different neurological disorders.</p>  |
| XXI                            | SOLS/<br>Biochem/C017 | 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: Immunoelectrophoresis, 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 Immunopathology and Transplantations including : Rh- blood groupings,</p> |

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|    |                               |              |   | 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.  |
|    | <b>SOLS/<br/>Biochem/E007</b> | Drug Design  | 3 | <p>This course aims at application of modern <i>in silico</i> tools or information technology in different phases of drug discovery and design of new drug candidates by understanding the molecular basis of the interaction of small molecules with their targets.</p> <p>It will present drug development as a process involving target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening.</p> <p>Students would have better understanding on the various stages of drug discovery.</p> <p>They would have studied on the various targets for drug discovery.</p> <p>They would have better understanding on the lead seeking method and lead optimization.</p> <p>They would have learnt the importance of the role of computer aided drug design in drug discovery.</p> <p>Student understands how current drugs were developed by using pharmacophores modeling and docking technique.</p> |
| 19 | SLS/MIC/E004                  | Dissertation | 6 | To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis.  |