Master of Science (Biochemistry)

Program Outcomes (POs)

PO01 Knowledge about Science: Foster learning through accumulation of knowledge in Science. Using research-based knowledge and research methods to provide valid conclusions.

PO02 Identification, Design/ Development of solutions to scientific problems: Apply knowledge of theories and practices of science to identify and solve problems related to science.

PO03 Analytical & Critical thinking: Foster analytical and critical thinking abilities for data-based decision making.

PO04 Ability to analyze the societal problems / issues: Ability to understand, analyze and communicate problems relevant to the society such as agriculture, food, health, environment, water and energy, which are related to science.

PO05 Individual and Team Work: Ability to lead self and others in the achievement of organizational goals, contributing effectively to a team environment and to communicate scientific information to stakeholders, being able to comprehend and write reports, develop documentation, make presentation and to give and receive clear instructions.

PO06 Usage of modern tools and techniques: Ability to adopt various tools for decision making and problem solving

PO07 Value based Leadership: Ability to develop value based leadership.

Program Specific Outcomes (PSOs)

Code	Title	Description
PSO01	Ability to explain the core concepts and theories in subjects associated with biochemistry.	Able to explain fundamental concepts and theories in Cell Biology of Cancer, General Microbiology, Metabolism of biomolecules, enzymology, Immunology, Molecular Biology, clinical Biochemistry, protein chemistry & biochemical techniques
PSO02	Demonstrate analytical and practical skills in biochemical investigations	Demonstrate critical thinking and reasoning skills in interpreting and explaining the results from diverse experimental investigative activities.
PSO03	Ability to design experiments based on biochemical principles and achieving translational outcomes	Able to apply the skills gained through original and publishable research studies, to evaluate the experimental results and demonstrate capacity to analyses research outcomes.
PSO04	Ability to communicate the knowledge in biochemistry subjects to a range of audience.	Presenting the project results to an audience of peers and faculty at national and international scientific platforms and demonstrate capability to defend their results
PSO05	Demonstrate leadership qualities in organizations requiring biochemistry expertise.	Exhibit originality in identifying, tackling and solving scientific problems, act independently in planning and taking decisions at a professional level and contribute to societal development as responsible and proven expertise in Biochemistry

Course Outcomes (COs)

2019-20 Batch

Semester	Course Code	Course Name	Course Outcomes (COs)
I	18MSBC1H01	Bioenergetics and Bioorganic chemistry	**CO1:** Define thermodynamic laws, high energy compounds, role of mitochondrion and chloroplasts in bioenergetics, types of isomerism and reaction intermediates, properties of water, buffers and hetrocyclic compounds **CO2:** Explain importance of thermodynamic laws, high energy compounds, factors influencing behaviors of high energy compounds, bioenergetic design of mitochondrial, chloroplast and microsomal electron transport chains, mechanism of ATP synthesis, use of inhibitors and uncouplers in the study of components of electron transport chain, atomic structure, reaction mechanisms and ligand replacement reactions, explain principles of isomerism. Explain the mechanism of action of buffers. Explain the structure of heterocyclic comounds and mechanisms of organic reactions. **CO3:** Calculate the Gibbs free energy change of electron transport reactions based on reduction potential of components, illustrate the importance of structure of water for its biological reactions, illustrate the biological importance of heterocyclic compounds **CO4:** Appraise the biological importance of water and role of Ligand replacement reactions and electron transfer reactions of organometalic moieties of biological macromolecules. Appraise the importance of antioxidant mechanisms and biological buffers

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I	18MSBC1H02	Microbiology	**CO1:** Appraise the historical perspectives, core concepts and scientific findings in the discipline of microbiology with specific knowledge on microbial pathogenicity, systematic classifications and industrial applications **CO2:** Build knowledge on culturing bacterial strains by understanding the physical and chemical growth requirements of bacteria to get equipped with various methods of bacterial growth measurements along with enumeration procedures. **CO3:** Compare beneficial/non-beneficial micro-organisms with respect to their applications and hazardous effects in food processing/preservation **CO4:** Classify the food borne pathogens/spoilage micro-organisms to attribute the characteristics of food borne illness and management strategies. **CO5:** Outline classification, life cycle, pathogenicity, cultivation and control measures of viruses in detail with respect to host immune system. **CO6 :** Develop the information related to environmental microbiology by learning biomass production/ biogas, use of microbes in pollution control and metal leaching for their beneficial applications towards the society.
I	18MSBC1H03	Biomolecules	**CO1:** Explain the biomedical importance and structural configurations of biomolecules with reference to carbohydrates and thereby execute/implement its commercial applications in pharmacological or clinical sector. **CO2:** Understanding the classification, properties and biological functions of amino acids and to analyze their role in formation of proteins as well as their structural elucidation for its commercial applications. **CO3 :** Illustrate the structural organization of various biologically active proteins at different levels and to apply on their mechanism of action in synthetic polypeptides that helps in the development of synthetic drugs. **CO4 :** Evaluate the physiological significance of other important biomolecules like lipids and nucleic acids that will help to execute strategies in chemical synthesis of for oligonucleotide by applying diverse methodologies.

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I	18MSBC1H04	Analytical Biochemistry-I	**CO1:** Summarize the clinical importance of using animals and cell cultures in Biochemical investigation in the field of research and development. **CO2:** Compare various principles and components of chromatographic techniques; accordingly, they can able to outline its features in analytical applications. **CO3:** Illustrate the electrophoretic technique and its applications in various fields. **CO4:** Sketch the instrumentation of Biosensors and differentiate various electrodes sensing mechanism that can help in the development of diagnostic tools. **CO5 :** Assess and prioritize the application of centrifugation and cytometer in analysis of cells and subcellular organelles.
I	18MSBC1H1L	General Biochemistry (practical)	**CO1:** Describe principles of methods of data acquisition, hands on experience on methods of data acquisition and reagent **CO2:** Experiment with the samples for qualitative and quantitative analysis of substances such as amino acids, carbohydrates, nucleic acids, vitamins, quality of fats. **CO3:** Assess given experimental samples for reaching inferences on quality or nature or amount of analyte being tested.
I	18MSBC1H2L	Techniques in Microbiology (practical)	**CO1:** Demonstrate safe practices in a microbiology laboratory and be masters in streak plate isolation and culturing techniques of bacteria, Staining techniques and micrometry **CO2:** Explain isolation and maintenance of the pure cultures of several bacterial strains for various biochemical investigations **CO3 :** Examine the inferences on bacterial growth studies, microbial nutrition and enzymatic reactions
I	18MSBC1H34L	Biochemical Techniques Lab	**CO1:** Analyze and execute the experiments as well as interpret the results from graphical data **CO2:** Compare and modify the protocol for getting prominent results of different chromatographic techniques. **CO3 :** Design and develop a procedure to address different problems in obtaining consistent results.

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II	**18MSBC2H01**	Enzymology	**CO1:** Classify the enzymes as well as describe their kinetics and biological functions; accordingly, they can execute its attributes for commercial applications in different fields. **CO2:** Differentiate the types of inhibition mechanism with various kinds of inhibitors **CO3:** Illustrate the structural aspect of an active site and its characteristics of an enzyme. **CO4:** Demonstrate the structural characteristics and biological role of coenzymes in different enzymatic reactions that helps in the development of diagnostic tools and other commercial applications **CO5:** Assess the mechanism of multi enzyme complex and their biological significance. **CO6:** Assess the concept of cooperativity and interaction of effector molecules with different protein domains. This further helps to execute strategies by applying diverse methodologies in compliance with protein ligand interaction.
II	**18MSBC2H02**	**Protein chemistry**	**CO1:** Describe the relationship between protein structure, function and their physicochemical properties **CO2:** Design methodologies for isolation, purification and characterization of proteins. **CO3:** Recommend data bases for searching information to visualize protein structures and compare amino acid sequences **CO4:** Demonstrate the fundamental mechanisms of protein folding with a deeper understanding of the factors determining the stability of protein. **CO5:** Articulate about functional diversityof proteins at subcellular locations **CO6 :** Compare the protein dynamics, structure and function

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II	**18MSBC2H03**	METABOLISM	**CO1:** Define key concepts and processes associated with catabolic and anabolic processes of carbohydrate, protein, lipid and nucleotide metabolism **CO2:** Summarize the molecular requirements for processes associated with catabolic and anabolic processes of carbohydrate, protein, lipid and nucleotide metabolism **CO3:** Illustrate the rationale for need for regulation of processes associated with catabolic and anabolic processes of carbohydrate, protein, lipid and nucleotide metabolism based on comprehensive understanding of overview of cellular physiology. **CO4:** Compare and contrast the mechanisms of key reactions that are involved in the catabolic and anabolic processes of carbohydrate, protein, lipid and nucleotide metabolism. Compare and understand the difference between anabolism and catabolism of biomolecules. **CO5:** Appraise the role of key enzymes involved in processes associated with catabolic and anabolic processes of carbohydrate, protein, lipid and nucleotide metabolism and appraise their physiological importance by study of diseases caused by their deficiencies. **CO6:** Develop strategies for improving nutrition for specific requirements and predict consequences of abnormalities in metabolism on physiology and health. Further, comprehensive understanding of metabolism is expected to enable them to create experimental hypothesis develop methods for evaluation of role of metabolic abnormalities to address the hypothesis.

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II	**18MSBC2H04**	ANALYTICAL BIOCHEMISTRY II	**CO1:** Define the principle of spectrophotometric analysis, properties of electromagnetic radiation and tissue culture techniques. **CO2:** Interpret X-ray/ UV-VIS/ flourescence spectroscopy and their applications in current research findings. **CO3:** Differentiate the principle, procedures and applications of various spectroscopic techniques including Mass Spectroscopy, circular dichorism spectroscopy, ORD, IR, ESR, NMR, EPR, FRET techniques **CO4:** Design clear protocols for characterizing and isolating molecules of interest for several biological applications. **CO5:** Articulate knowledge on the general properties/ types of radio-isotopes, method of detection of radio-isotopes, autoradiography, basic concepts of radiation protection standards, disposal/management of radioactive wastes and use of radioactive and non-radioactive isotopes in biochemistry **CO6 :** Employ the crystal structure by X-ray crystallography, radiographic and fluoroscopic images in X-Ray systems, Evolution of CT machines, Introduction to Emission Tomography including Positron Emission Tomography (PET), Single Photon Emission Computed Tomography for several important applications in medical field.
II	**18MSBC2H1L**	**Enzyme kinetics lab**	**CO1:** Analyze and execute the experiments as well as interpret the results from graphical data **CO2:** Determine and modify the protocolfor getting prominent results of various enzyme kinetics. **CO3 :**Develop a technique to address different problems in research and development for societal benefit
II	**18MSBC2H2L**	**Protein chemistry lab**	**CO1:** Discuss scientific problems within the area of protein chemistry that can be tackled and solved by experiments **CO2:** Compare the theories learned about characteristics of protein and obtained experimental results **CO3 :** Design experiments and expand the investigation in a project-oriented manner and will be adapted to work in a group

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III	18MSBC3H01	Clinical biochemistry	**CO1 :** Interpret the functional principles of clinical laboratory procedures, collection and preservation of biological specimens, assay techniques along with their automation, results of investigations and the quality control measures **CO2 :** Differentiate type I and II diabetes mellitus and the role of functional and non-functional serum enzymes and understand their clinical utility as diagnostic markers in diverse diseases associated with cardiac, hepatic, muscle, bone, prostatic tissue etc along with their assay methods and describe the relationship between biological markers and disease pathology **CO3 :** Judge the diagnosis of atherosclerosis, metabolic diseases, liver and gastric dysfunctions through plasma lipid profiling, gastric and liver functions tests **CO4 :** Propose diagnostic modalities for diverse pathological conditions associated with kidney functions towards pH,electrolyte and water level regulation
III	18MSBC3H02	Molecular biology-I	**CO1 :** Define fundamental concepts of molecular biology **CO2 :** Explain prokaryotic, eukaryotic and viral replication **CO3 :** Illustrate recombination and DNA repair mechanisms **CO4 :** Differentiate between prokaryotic and eukaryotic transcription
III	18MSBC3S31	Plant Biochemistry	**CO1 :** Define components of electron transport chain and metabolic pathway in chloroplast, components of nitrogen fixing system, plant hormones, secondary metabolites plant toxins and defense mechanisms. **CO2 :** Explain the mechanism of ATP and NADPH synthesis and carbon dioxide fixation in plants. Describe mechanism of nitrogen fixation, functions of hormones in plant physiology **CO3 :** Illustrate biosynthesis of hormones, secondary metabolites and defense mechanism in plants. Illustrate the biochemical properties and cellular functions. Illustrate Mobilization of food reserves during seed germination; hormonal control of seed germination and seedling growth. **CO4 :** Appraise the importance of different mechanisms of carbon dioxide fixation and secondary metabolites in plants.

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III	18MSBC3S32	**Cell Biology and Cancer**	**CO1 :** Define all subcellular components, define intrauterine stages of development, and define types of cancer **CO2 :** Explain structure and functions of sub-cellular components, cytoskeleton network and cell-cell junctions. Explain molecular basis of cancer. Explain phases and significance of apoptosis. Explain different strategies for treatment of cancer. Explain intracellular changes associated with cell cycle and molecular basis of cell division. Explain the mechanism of angiogenesis. **CO3 :** Illustrate changes associated with apoptosis, illustrate role of signaling pathways in cancer and mechanisms of anticancer drugs. Illustrate cellular changes associated with development. **CO4 :** Compare different routes of sub-cellular protein trafficking, differentiate between necrosis and apoptosis and mechanisms of intrinsic and extrinsic apoptosis. . Compare between mitosis and meiosis. **CO5 :** Appraise importance of mitochondria in apoptosis, appraise role of epigenetic mechanisms in cancer and appraise the balance between pro-apoptotic and antiapoptotic mechanisms in cell physiology and cancer. Assess the role of angiogenesis in cancer. **CO6 :** Apply the understanding of role of subcellular components and molecular basis of cancer to develop hypothesis or tools for exploring the area of diagnostics and therapeutics in cell and cancer biology.
III	18MSBC3S33	**Biotechnology**	**CO1 :** Interpret the functional principles of biotechnological applications at industry and academia levels **CO2 :** Differentiate utility of diverse RDNA technology tools **CO3 :** Judge the utility and application potential of recombinant DNA technology in therapeutic field **CO4 :** Propose suitable cloning strategy with step-by-step instructions to address a research problem
III	18MSBC3H1L	**Clinical biochemistry (practical)**	**CO1 :** Discuss scientific problems within the area of medical biochemistry that can be tackled and solved by experiments **CO2 :** Compare the theories learned about characteristics of diverse disorders with the outcome of experiments to facilitate diagnostic process **CO3 :** Develop awareness of different pathologies associated with lifestyle by reviewing the information from each category of tests

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III	**18MSBC3H2L**	**Molecular Biology Lab (Practical)**	**CO1 :** Examine experimental problems in the area of Molecular Biology. **CO2 :** Analyze experimental results to draw inferences **CO3 :** Develop molecular biology techniques to solve scientific problems in allied research domains.
IV	**18MSBC4H01**	**Molecular Biology II**	**CO1 :** Memorize the general characteristics of genetic code, Nierenberg and Khorana's work in deciphering genetic code; wobble hypothesis, prokaryotic and eukaryotic ribosomal constituents and their importance in translation, post-translational mechanisms and control. **CO2 :** Create knowledge on regulation of gene expressions in prokaryotes by learning operon model and mechanisms, RNA silencing, gene regulation by short and long non-coding RNAs, Functional genomics using microarray technique along with enumeration procedures. **CO3 :** Illustrate about gene expression in eukaryotes, chromatin structure/ remodeling mechanisms, components involved in multiple transcription control elements, regulation of mating type genes in yeast and to learn genetic regulation of development in drosophila. **CO4 :** Outlinemolecular oncology, Etiology of cancer and understanding the mechanisms of chemotherapeutic drugs. **CO5 :** Discriminate events of cell cycle and their regulations, cell adhesion molecules and their role in cell differentiation/development
IV	**18MSBC4H02**	**Immunology**	**CO1 :** Describe innate and adaptive immune responses and cells and organs of immune system. **CO2 :** Explain structure, function aspects of immunoglobulins and immunogenicity. **CO3 :** Demonstrate genetic basis for the generation of diversity in immune system **CO4 :** Illustrate cellular and molecular basis of immune response, its activation and regulation. **CO5 :** Summarize T and B cell interactions, complement system and basis for immunization. **CO6 :** Formulate immunoassay methods for clinical studies using deeper understanding of immune disorders and immunological techniques

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IV	18MSBC4H03	**Research Methodology & Biostatistics**	**CO1 :** Describe types and language of research **CO2 :** Explain various sampling, data collection, analysis and presentation methods **CO3 :** Apply statistical methods and software in research studies. **CO4 :** Demonstrate data interpretation and paper writing skills **CO5 :** Evaluate research concepts using statistical inferences **CO6 :** Develop research hypothesis to formulate research project.
IV	18MSBC4S41	**Signal Transduction and hormones**	**CO1 :** Define different components of endocrine system and signal transduction mechanisms as hormones, secondary messengers, receptors and relate the hormones to their secretory sources **CO2 :** Describe and Summarize the functions of all listed hormones and compare the functions of opposing hormonal influences on homeostatic processes **CO3 :** Apply rationale for explaining the role of hormones in maintenance of physiological homeostasis **CO4 :** Categorize hormones based on different attributes and explain their mechanism of action to draw a conclusion for understanding their functions. **CO5 :** Evaluate role of different receptors, secondary messengers and terminating mechanisms to understand regulation of hormone functions. **CO6 :** Apply the understanding of role of hormones to study the effect of their deficiency and excess levels on homeostasis, develop hypothesis and create experimental approach for studying role of endocrine dysregulations in disease biology.
IV	18MSBC4S42	**Developmental Biology & Neurochemistry**	**CO1 :** Describe cellular basis of development with respect to cleavage patterns, gastrulation, blastulation and neurulation **CO2 :** Explain the process of oogenesis and spermatogenesis **CO3 :** Use model organisms to illustrate embryonic development and morphogenic process **CO4 :** Classify and illustrate structure function aspects of neuronal cells **CO5 :** Summarize physiological aspects of action potential, synaptic transmission and neurotransmitters **CO6 :** Design experimental model to study developmental biology and neurochemistry

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IV	18MSBC4S43	Biochemical Genetics	**CO1:** Memorize the important mechanisms and types of gene mutation, Morgan's discovery of sex linked inheritance, pattern of inheritance and their role in genetic studies. **CO2 :** Discuss on human quantitative traits, biochemical events in mitosis/meiosis cell divisions, chromosome mapping along with chromosomal abnormalities **CO3 :** Illustrate the gene structure in eukaryotic organisms which are essential tools for research in molecular microbiology and medicine. **CO4 :** Compare bacterial and viral genetic elements, life cycle events, mechanism of recombination, transposable genetic elements and conjugation mechanisms **CO5 :** Create knowledge on medical applications including development of new vaccines, biologics, diagnostic tests and therapeutic methods. **CO6 :** Discriminate biological rhythms in drosophila, nest clean behavior of honey bee, population and evolutionary genetics, polymorphism of chromosome structure and human evolution.
IV	18MSBC4H1L	Immunology Lab (Practical)	**CO1 :** Examine experimental problems in the area of immunology. **CO2 :** Analyze experimental results to draw inferences **CO3 :** Develop immunological techniques to solve scientific problems in allied research domains.
IV	18MSBC4P6	PROJECT WORK	**CO1 :** Demonstrate knowledge of the objective, methods, results and conclusions of their research project. **CO2 :** Examine critically an experimental data and an original paper in the literature and give presentations **CO3 :** Decide appropriate basic statistical methods **CO4 :** Assemble the knowledge gained through research to formulate a report which can lead to scientific publications