

Program Name: **B.Sc. Biochemistry**

- PSO1.** Describe the nature and basic concepts of all subjects that collate to applicability of Biochemistry.
- PSO2.** Analyse biochemical systems, such as, changes associated with stressful conditions, evolutionarily conserved pathways, genetic, nutritional and environmental adaptations etc, and link it with life in all forms,
- PSO3.** Learn technical skills through laboratory sessions/ research projects and develop self-directed experiential learning
- PSO4.** Ability to communicate the understanding of the learning to others
- PSO5.** Extend the applicability of Biochemistry to service learning and nation development through awareness programmes/ action - oriented projects in health, nutrition, and environment

**Course outcomes for all courses offered by the department:**

<b>Semester</b>	<b>Course Code</b>	<b>Course name</b>	<b>Course Outcomes Student completing this course is able to</b>
1	BC-1501	Fundamentals of Biochemistry	1: To explain the importance of having water as a solvent system in cells 2: To spell out the importance of bonding and spatial arrangements of molecules for proper functioning and stability. 3: To establish the concept of how proper conformations are needed for optimum functioning of the molecules and thereby the entire cell 4: To specify how proteins, carbohydrates, lipids and nucleic acids can contribute to structural integrity of the cell as well as the biochemical reactions. 5: To analyse how a change in the structure of the molecules can lead to abnormalities, for eg. Amutated globin results in sickle cell anaemia 6: To state both the physical as well as chemical properties of these biomolecules, as these properties can be used to carry out various studies. 7: Appreciate experiments carried out by scientists to enable understand the structure of biomolecule
2	BC-2501	Concepts in Cell Biology	1: To explain the evolution of a cell and the role of nucleic acids in evolution 2: To describe the importance of semi permeable nature of plasma membrane in maintaining the integrity of a cell.

			<p>3: To establish the concept of how proper conformations of lipids and proteins in a membrane are needed for optimum functioning</p> <p>4: To clarify how important each organelle is to make cell the basic unit of life – the entire organization within a cell is a perfect example of division of labour with proper coordination and networking.</p> <p>5: To demonstrate how a change in the structure of the molecules can lead to abnormalities, for eg. Improper glucose transporter can affect blood sugar homeostasis</p> <p>6: To question why a cell cycle needs to be regulated and when does a cell need to die.</p> <p>7: Appreciate experiments carried out by scientists to enable understand the working of a cell, design of experiments to prove the same and analyse the data and give interpretations.</p>
3	BC-3501	Concepts in Microbiology	<p>1: To explain the morphology of a prokaryotic cell and the fine structure of its organelles</p> <p>2: To differentiate between eubacteria, archaeobacteria, fungi, algae and viruses and comprehend their economic importance.</p> <p>3: To justify the discovery and advancement of microscopic techniques has led to revolutionizing the field of microbiology</p> <p>4: To describe the basic growth requirements of bacteria in vitro in order to culture them.</p> <p>5: To know methodologies to control the growth of microbes by various sterilization techniques and chemotherapeutic drugs. For example: Milk is pasteurized to ensure that its shelf life is long; keeping surgical tools and rooms free of pathogens etc.</p> <p>6: To defend that good bacteria play a major role in industries especially food industries</p> <p>7: To justify how microbes have been a tool to minimise use of chemicals, improvise waste water treatment and decreasing environmental pollution by biodegradation</p> <p>8: Appreciate experiments carried out by scientists to enable understand the use of microbial systems in enhancing the quality of life.</p>
3	BC-3502	Biophysical Chemistry	<p>1: To state the basic concepts of physics like adsorption, viscosity, surface tension, absorption of light to be able to apply in understanding concepts in biochemistry</p> <p>2: To correlate the use of a particular technique to understand a fundamental.</p>

			<p>3: To justify that the discovery and advancement of biophysics has opened up understanding pathways and mode of actions of various biological systems.</p> <p>4: To apply the techniques for production, analysis and modifications of biomolecules.</p> <p>5: Design experiments with appropriate techniques in the methodologies and analyze the data obtained.</p>
4	BC-4501	Molecular Physiology	<p>1: To justify that physiological functions of cells are aided and regulated by signal molecules like hormones, owing to its specificity and transduction mechanisms, which in turn become a target for treatment of various ailments</p> <p>2: To describe the molecular mechanisms involved in blood clotting, production of erythrocytes, leucocytes and thrombocytes. This also gives an insight into molecular mechanisms that could be induced to enhance production of cells in vitro.</p> <p>3: To explain the underlying mechanisms involved in movement of different muscle types to facilitate specific functions.</p> <p>4: To state the importance of secretions and absorption in the body to aid digestion, circulation and excretions. The mechanisms involved will also enable comprehend what happens when there is any defect in any of the steps.</p> <p>5: Appreciate experiments carried out by scientists to enable understand the basic concepts involved in signalling, transport, regulation and movement.</p>
4	BC-4502	Nutrition	<p>1: To explain simple concepts related to Nutrition like balanced diet, RDA etc.,</p> <p>2: To correlate between food and energy requirements and utilization;</p> <p>3: To demonstrate why the body requires carbohydrates, lipids and proteins in specific quantities and how its deficiency or excess can lead to disorders</p> <p>4: To assess the contribution of minerals, trace elements and vitamins to the well being of humans.</p> <p>5: Appreciate experiments carried out by scientists to enable understand the requirement of different molecules by the body</p>
5	BC-5501	Metabolism-I	<p>1: To understand simple concepts related to metabolism,</p>

			<p>2: To see the correlation between energy molecules, reducing equivalents and pathways;</p> <p>3: To comprehend how metabolism is regulated by enzymes and hormones</p> <p>4: To compare anabolic and catabolic pathways of carbohydrates, proteins and nucleic acids and comprehend how any defect in a pathway could lead to diseases.</p> <p>5: Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism</p>
5	BC-5502	Molecular Biology-1	<p>1: To analyse the experiments carried out by various scientists to prove that DNA is the genetic material,</p> <p>2: To explain the structure and properties of DNA;</p> <p>3: To narrate the mechanisms of DNA replication, transcription and translation in prokaryotes</p> <p>4: To evaluate how DNA damage can lead to detrimental effects and how DNA repair systems in the cells try to prevent mutations before being inherited.</p> <p>5: To outline how cells regulate expression of genes during transcription</p> <p>CO6: Appreciate experiments carried out by scientists to enable understand the Central Dogma of life</p>
5	BC-5503	Enzymology	<p>1: To describe the structures and functions of enzymes and its classification</p> <p>2: Relate the parameters associated with enzyme activity</p> <p>3: To outline mechanisms of catalysis and the involvement of various cofactors and coenzymes in the process;</p> <p>4: To know concepts on how to purify a protein using various techniques</p> <p>5: To reason out how the rate of reaction of an enzyme is affected by physical and chemical factors</p> <p>6: To differentiate between regulatory enzymes and non-regulatory enzymes through kinetic studies</p> <p>7: Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism</p>
5	BC-5504	Applied Biochemistry	<p>1: To demonstrate how understanding of biochemistry of various processes enable applying to diagnostics, analysis and therapy,</p> <p>2: To appraise how enzymes are used at an industrial level;</p>

			<p>3: To prove how simple fermentation processes yield economically important products</p> <p>4: To develop upstream and downstream processing</p> <p>5: To study various products obtained by fermentation</p> <p>6: Appreciate experiments carried out by scientists to enable practical applications of theory</p>
5	BC-5401	Research methodology and Biostatistics.	<p>1: Develop most appropriate research strategy.</p> <p>2: Know and use different methods and strategy for research.</p> <p>3: Know basics of Statistics,</p> <p>4: Analyse and interpret experimental results.</p>
6	BC-6501	Metabolism-II	<p>1: To compare breakdown and synthesis of fatty acids and its regulation,</p> <p>2: To link the various pathways and cycles that contribute to synthesis of ATP, which in turn would be used up for various synthetic pathways, thereby establishing ATPcycle.</p> <p>3: To compare the roles of mitochondria and chloroplast in ATPsynthesis.</p> <p>4: To relate metabolism in different conditions, in different tissues, and how intermediates connect several metabolic pathways, thus, relating a single pathway to various metabolic disorders</p> <p>5: Appreciate experiments carried out by scientists to enable understand the pathwaysand cycles of metabolism</p>
6	BC-6502	Molecular Biology-II	<p>1: To explain complex mechanisms like homologous recombination and transposition and look at the importance of these in the cells.</p> <p>2: To appraise the basic tools required in recombinant DNATEchnology</p> <p>3: To demonstrate the various techniques in molecular biology and their applications</p> <p>4: To evaluate the use of recombinant DNATEchnology in betterment of the society</p> <p>5: Appreciate experiments carried out by scientists to enable understand various molecular mechanisms</p>
6	BC-6503	Immunology	<p>1: To describe the immune system of our body, the different organs and cells that enable us to fight viruses and pathogens,</p> <p>2: To assess the significance of antigen and antibody interactions and use this specificity for various applications;</p> <p>3: To explain underlying mechanisms allowing the immune cells and molecules to kill the pathogens just like an army defends ones country</p>

			<p>4: To fathom what would happen if the mechanisms sensitize our body such that it proves detrimental to our own system eg. Asthmatic attacks</p> <p>5: To prove that a natural phenomenon can be used as a basis to producing vaccines, which have been responsible for eradication of diseases like small pox and now polio</p> <p>6: To demonstrate that experiments carried out by scientists to enable understand the mechanisms underlying immune responses</p>
6	BC-6504	Genetics	<p>1: Apply the principles of Mendelian inheritance and their extensions by analysing inheritance patterns from crosses</p> <p>2: Map genes in microorganisms and eukaryotes by 2- or 3-point test crosses</p> <p>3: Describe the origins and genetic consequences of mutations and chromosomal abnormalities</p> <p>4: Describe the concept of maternal inheritance, epigenetics and evolutionary genetics</p> <p>5: Analyse basic processes in population genetics, mutation, migration, natural selection and genetic drift and describe how they affect the genetic diversity within a species</p> <p>6: Appreciate experiments carried out by scientists to enable understand genetics</p>
1	BC-1502L	Biochemistry Practicals	<p>1: To explain the importance of various instruments used in biochemistry.</p> <p>2: To establish the concept with lab sessions</p> <p>3: To analyse and to identify carbohydrates</p> <p>4: To experimentally prove both the physical as well as chemical properties of these biomolecules, as these properties can be used to carry out various studies.</p> <p>5: Appreciate experiments carried out by scientists to enable understand the structure of biomolecules, understand their properties, design of experiments to prove the same and analyse the data and give interpretations</p>
2	BC-2502L	Fundamentals of Biochemistry Practicals	<p>1: To explain the importance of various biomolecules and correlate concepts with lab sessions</p> <p>2: To analyse and to identify proteins and lipids</p> <p>3: Appreciate experiments carried out by scientists to enable understand the working of a cell, design of experiments to prove the same and analyse the data and give interpretations.</p>
3	BC-3503L	Fundamentals of Biophysical	<p>1: Appreciate experiments carried out by scientists to enable understand the use of microbial systems in enhancing the quality of life.</p>

		techniques and Microbiology	<p>2: To apply the techniques for production, analysis and modifications of biomolecules.</p> <p>3: Design experiments with appropriate techniques in the methodologies to study various aspects of microorganisms</p>
4	BC-4503L	Nutrition and Haematology practicals	<p>1: Appreciate experiments carried out by scientists to enable understand the basic concepts involved in signalling, transport, regulation and movement.</p> <p>2: To assess the contribution of minerals, trace elements and vitamins to the well being of humans.</p> <p>3: Appreciate experiments carried out by scientists to enable understand the requirement of different molecules by the body</p>
5	BC-5505L	Clinical Biochemistry, Molecular Biology, Enzymology practicals	<p>1: Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism</p> <p>2: To isolate DNA and to study its properties</p> <p>3: To differentiate between regulatory enzymes and non regulatory enzymes through kinetic studies</p> <p>4: Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism</p>
6	BC-6505L	Biochemistry, Molecular Biology, Immunology and Genetics Practicals	<p>1: To relate metabolism in different conditions, in different tissues, and how intermediates connect several metabolic pathways, thus, relating a single pathway to various metabolic disorders</p> <p>2: Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism</p> <p>3: Appreciate experiments carried out by scientists to enable understand various molecular mechanisms</p> <p>4: To demonstrate that experiments carried out by scientists to enable understand the mechanisms underlying immune responses</p> <p>5: Analyse basic processes in population genetics, mutation, migration, natural selection and genetic drift and describe how they affect the genetic diversity within a species</p> <p>6: Appreciate experiments carried out by scientists to enable understand genetics.</p>

## Vocation biotechnology Course

### Course Objectives

- Comprehending applications of concepts in basic subjects of Biochemistry and Biotechnology
- Experience nuances of entrepreneurship, work ethics of an industry/ Research organization in Biochemistry and Biotechnology
- Acquire technical skill set related to research and employability in Biotechnology
- Acquire ability to impart training in techniques related to the subject
- Evaluate the ethical, legal and social issues pertaining to use of biological systems

Semester	Course Code	Course name	Course Outcomes Student completing this course is able to
1	BT-1401	Plant Biochemistry	<p>1: To explain the basic concepts and techniques in plant biotechnology, especially the importance of standard operating procedures for successful culture establishment.</p> <p>2: To comprehend the pros and cons of the various techniques in Agriculture, Environment and Industry/ Commercial set up.</p> <p>3: To assess how crops have been improved and evolved due to specialized techniques like hybridization, mutagenesis and transgenics</p> <p>4: To be aware and be sensitive to ethical concerns related to genetic modifications in plants</p> <p>5: To appraise how industry has been able to scale up the production of commercially important plant based products</p>
1	BT-1402L	Plant Tissue Culture#	<p>1: To present the basic concepts and techniques in plant biotechnology, and experimentally establish</p> <p>2: To assess how crops have been improved and evolved due to specialized techniques like hybridization, mutagenesis and transgenics</p> <p>3: To appraise how industry has been able to scale up the production of commercially important plant based products</p>
2	BT-2401	Biostatistics and Entrepreneurship	<p>1: To know the basic concepts and importance of statistics in biology</p> <p>2: To compare the various nuances of sampling techniques</p> <p>3: To plan and execute basic research</p> <p>4: To analyze and interpret data using the learned concepts</p> <p>5: To assess the journey of successful entrepreneurs and gauge one's own potential</p> <p>6: To crystallize a business idea and develop a business plan</p>

2	BT-2402L	Biostatistics and Entrepreneurship (Mini-Project)#	<p>1: To compare the various nuances of sampling techniques</p> <p>2: To plan and execute basic research</p> <p>3: To analyze and interpret data using the learned concepts</p>
3	BT-3401	Animal Biotechnology	<p>1: To describe the concept of growing animal cells in vitro</p> <p>2: To explain the importance of specifications in design of laboratory and working to avoid contamination</p> <p>3: To assess how transfection studies enable production of cloned products necessary for medical and pharmaceutical applications</p> <p>4: To spell out experimental designs by scientists to develop techniques for production of vaccines, monoclonal antibodies etc.</p> <p>5: To evaluate how animal cell culture has been instrumental in basic research</p>
3	BT-3402L	Basic techniques in animal cell culture and immunology#	<p>1: To describe the concept of growing animal cells in vitro</p> <p>2: To spell out experimental designs by scientists to develop techniques for production of vaccines, monoclonal antibodies etc.</p> <p>3: To evaluate how animal cell culture has been instrumental in basic research</p> <p>4: To carry out immunological experiments</p>
4	BT-4401	Environmental and Industrial Biotechnology	<p>1: To narrate the importance of requirement of alternate fuels and its production</p> <p>2: To explain the reclamation of contaminated water and soil by bioremediation</p> <p>3: To demonstrate how some microbes are able to degrade xenobiotics and how some microbes enable assimilability of nutrients</p> <p>4: To evaluate using biological systems to recover trace elements, to control growth of weeds, pests etc., Clean the environment by waste water and solid waste management.</p> <p>5: To summarize how industries have used bioprocessing techniques</p> <p>6: To formulate the importance of quality control, assurance and regulatory policies in industries</p>
4	BT-4402L	Basic Environmental & Industrial BT Techniques#	<p>1: To demonstrate how some microbes are able to degrade xenobiotics and how some microbes enable assimilability of nutrients</p> <p>2: To evaluate using biological systems to recover trace elements, to control growth of weeds, pests etc., Clean the environment by waste water and solid waste management.</p> <p>3: To carry out the importance of quality control, assurance and regulatory policies in industries</p>
5	BT-5401	Medical Biotechnology	<p>1: To explain the basic mechanism of RNA interference and how RNAi has been developed to be used in therapeutics</p>

			<p>2: To assess the use of stem cells for treatment of various disorders</p> <p>3: To comprehend the ethical issues related to use of stem cells</p> <p>4: To appreciate how understanding of molecular mechanisms has enabled therapeutic progress towards customized and target specific regimes</p> <p>5: To perceive the challenges in RNAi technology, stem cell therapy and cancer therapy</p> <p>6: To evaluate the role of mechanics and engineering in enabling diagnosis and treatment</p> <p>7: Recognize how Bioinformatics as a tool is leading to drug discovery and analysis of medical conditions</p>
5	BT-5402L	Basics of Bioinformatics Practicals #	<p>1: To learn to use various bioinformatics softwares</p> <p>2: To appreciate how understanding of molecular mechanisms has enabled therapeutic progress towards customized and target specific regimes</p> <p>3: To carry out various bioinformatics tools to analyse genome</p> <p>4: Recognize how Bioinformatics as a tool is leading to drug discovery and analysis of medical conditions</p>
6	BT-6401	Concepts in Recombinant DNA Technology	<p>1: To explain the basic tools required in recombinant DNA technology especially in eukaryotic systems</p> <p>2: To explore the methods used to study gene location and structure</p> <p>3: To know the various techniques used to study the gene expression and regulation</p> <p>4: To describe the techniques used in analyzing transcripts and proteins</p> <p>5: To clarify the problems associated with production of recombinant molecules</p> <p>6: To explore the use of recombinant DNA technology in betterment of the society</p> <p>7: Appreciate experiments carried out by scientists to enable understand various molecular mechanisms</p>
6	BT-6402L	Techniques of Recombinant DNA technology	<p>1: To explore the methods used to study gene location and structure</p> <p>2: To carry out the various techniques used to study the gene expression and regulation</p> <p>3: To explore the use of recombinant DNA technology in betterment of the society</p> <p>4: Appreciate experiments carried out by scientists to enable understand various molecular mechanisms</p>