**BSc. (Hons.) Bio-Chemistry**

**Learning Outcomes**

**SEMESTER -I**

**DSE 1: BIOMOLECULES**

**Learning Objectives:**

This paper will provide an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties of molecules, biological roles and functions for students. Emphasis will be on the association between structure and function of various biomolecules at a chemical level with a biological perspective and hands-on approach and laboratory techniques.

**Learning outcomes**

On successful completion of the course students will be:

- Able to comprehend the structure, function and acid-base properties of amino acids.
- Introduced to the structure, properties and roles of carbohydrates, lipids and nucleic acids, Aware of the importance of vitamins in biological systems.
- Able to independently identify various biomolecules in the laboratory by qualitative test methods.
- Acquainted with chemical and molecular foundations of life and appreciate the role of buffer in biological systems.

**DSE 2: PROTEINS**

**Learning Objectives:**

The course aims to introduce "proteins" and their importance to modern biochemistry, highlighting their structural features and unique characteristics that help them participate in

every physiological process in life, thus also playing an important role in disease manifestation and their interventions.

**Learning Outcomes**

After completion of the course, a student will

- Understand the diverse functions of proteins in a cell
- Understand the hierarchy of protein architecture primary, secondary, tertiary & quaternary structure, with the ability to distinguish features of globular & fibrous proteins
- Be able to comprehend the fundamental mechanisms of protein folding and stability and their relation to conformational diseases
- Understand specialized proteins like structural proteins
- Gain comprehension of structure-function relationship of proteins and their significance in physiology, diseases and applications in industry and medicine.

**DSE 3: BIOCHEMICAL TECHNIQUES**

**Learning Objectives:** The objective of the course is to introduce various techniques to students that are used in a biochemistry lab. It will provide them an understanding of the principles underlying various techniques. They will develop skills in the form of practical exercises and gain knowledge, which can be applied to pursue research and will be helpful in getting a suitable placement.

**Learning Outcomes**

On successful completion of this course, the students

- will Acquire knowledge about the principles and applications of spectrophotometric and chromatographic techniques used in a biochemistry lab.

- Learn about the principle and applications of electrophoresis and centrifugation techniques.
- Will be able to identify biochemical techniques for separation and purification of biomolecules.
- Students will obtain hands-on experience to develop their experimental skills expected from any biochemistry student working in a research lab.

**Learning Objectives**

- The objective of the course is to provide students with an understanding of biomolecules, the basic building blocks that are vital for various life forms.
- The course emphasizes on studying the different types of biomolecules focusing on their key properties, biological roles and functions.
- The course also aims to outline chemical and physical aspects of biomolecules by hands on approach through laboratory experiments.

**Learning Outcomes**

- The course will provide an understanding of how the structure of biomolecules determine their chemical properties and functions.
- Students will develop understanding of biochemistry at atomic level and appreciate the biological importance of each biomolecule.
- Students will gain insight into basic structures, classification, chemistry and properties of amino acids, carbohydrates, lipids and nucleic acid along with their biological role.
- Students will learn about the nutritional roles of water soluble and lipid soluble vitamins in the body along with their occurrence.

**SEMESTER -II**

**DSE 4: ENZYMES**

**Learning Objectives**: The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life, so as to develop an understanding of enzyme kinetics, mechanism of enzyme action and their regulation. The course also aims to outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry.

**Learning outcomes**:

- Students will learn the nature and importance of enzymes in living systems
- Students will gain insight into the thermodynamic and molecular basis of catalysis by enzymes and the underlying basis of their specificity.
- Students will understand the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors.
- Students will also learn to appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the ceH.
- The course will introduce· students to the applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.

**DSE 5: METABOLISM OF CARBOHYDRATES**

**Learning Objectives**

The objective of this course is to provide an understanding of metabolism of carbohydrates and the enzymes involved in various metabolic pathways and regulation of carbohydrate metabolism in cells. The course also aims to outline the importance of such pathways in relation to metabolic defects.

**Learning outcomes**

Carbohydrates major biomolecules as building blocks in any organism. A understanding of the metabolism of these groups of molecules will help students to know the functioning of an organism as a whole. There are various degradation and synthesis pathways these molecules undergo based on the energy requirement of an organism so as to maintain body homeostasis. Detailed analysis of the pathways will provide an insight into the diseases caused by defects in metabolism highlighting the importance of the same. The metabolism of carbohydrate course will provide to undergraduate students:

- Concept of metabolism, characteristics of metabolic pathways and strategies used to study these pathways.
- Detailed knowledge of various pathways involved in carbohydrate metabolism with the enzyme involved and regulation.
- Diseases caused by defects in metabolism with emphasis on the metabolic control and cure of diseases.
- Understanding of various metabolic pathways in animals.

**DSE-6: BASIC CONCEPTS WITH OF CELL BIOLOGY**

**Learning Objectives**

This course will acquaint the students to the subject of Cell Biology and the types of cell divisions seen in the living system. It deals with the details of cell organelles and cell wall. It also explains the molecules which make up the matrix and the proteins which make the framework of the cell as cytoskeleton elements. It also introduces the various tools and techniques of cell biology which are used to study the cell.

**Learning outcomes**

After the completion of the course, the students will have:

- Insights into the basic structure and function of the cell and cellular organelles.
- Introduction to the concept of model systems, cell division and cell to cell interaction
- Understanding of the structural framework of the cell as cytoskeletal structures
- Knowledge of various techniques used in cell biology experiments

**SEMESTER -III**

**DSE-7: METABOLISM OF LIPIDS**

**Learning Objectives**

- The aim of this course is to give students an exhaustive understanding of lipid metabolism, enzymes involved in various catabolic and anabolic pathways of lipids, and their regulation. The course will also discuss the significance of such pathways in the context of metabolic disorders.

**Learning outcomes**

On successful completion of the course students will be able to:

- Explain the concepts of metabolism of lipids, characteristics of metabolic pathways and strategies used to study these pathways.
- Apply the knowledge of various catabolic and anabolic pathways in lipid metabolism and their regulation.
- Describe the diseases caused by defects in metabolism with emphasis on metabolic control.

## DSE-8: BIOENERGETICS

### Learning Objectives

On successful completion of the course students will be able to:

The objective of the course is to provide students with the basic und thermodynamic principles, bioenergetics and the roles of high encrgy metabolism. The course will also provide an understanding of the biological reduction reactions. The course will introduce students to the detailed molecular mechan1sms of oxidative phosphorylation and structural as well as functional aspects of ATP synthase. The course will provide an in-depth knowledge of photophosphorylation

### Learning outcomes

On successful completion of the course students will be able to:

- Describe the basic tencts of thermodynamics and energy transfomations that are taking place in the cell
- Elaborate the basic mechanisms photophosphorylation in plants and microbes.
- Explain the biological oxidation-reduction reactions and the mechanisms of clectron transfer by elcectron carriers.
- Appreciate the concept of chemiosmotic theory and the mechanism of oxidative phosphorylation and ATP synthesis.

## DSE-9: MEMBRANE BIOLOGY

### Learning Objectives

The objective of the course is to provide students with the basic understanding of membrane composition, structure-function relationship and properties of membranes. The course will also provide an understanding of the various types of membrane transnnrtere and their molecular

mechanisms. This course also provides understanding mechanisms involved in vesicular transport processes and membrane fusion.

**Learning outcomes**

On successful completion of the course students will be able to:

- Apply the knowledge gained about the molecular mechanism of vesicular transport and membrane fusion to understand the functioning of cells.
- Elaborate various types of membranc transport mechanisms.
- Describe the basic properties of such as membrane fluidity.

**SEMESTER -IV**

**DSE-10: METABOLISM OF AMINO ACIDS AND NUCLEOTIDES**

**Learning Objectives**

The main objective of the course is to offer detailed and comprehensive knowledge about the synthesis and degradation pathways of amino acids and nucleotides and their importance in the proper functioning the cells. This course also interrelates the metabolism of these molecules with respect to health diseases in addition to providing an overview of inhibitors of metabolism for treating the diseases of metabolic disorders.

**Learning outcomes**

On successful completion of the course, students will be able to:

- Explain the importance of nitrogen cycle.
- Explain the degradation and biosynthetic pathways of amino acids and nucleotides in humans.
- Discuss the importance of amino acids as precursors to a variety of important biomolecules.

- Examine the role of inhibitors of nucleotide metabolism as chemotherapeutic drugs
- Discuss the integration of the amino acid, nucleotide, carbohydrate and lipid metabolism

## DSE-11: HORMONES: BIOCHEMISTRY AND FUNCTION

### Learning Objectives

The course is designed to enable the students to understand and appreciate the delicate network and balance of hormones required for the healthy functioning of the huma course emphasizes on studying the different types of hormones along with their action. The students will be taught the consequences of any hormonal imbalance. underproduction of hormones) with special emphasis on human discases. understanding of the different endocrine factors that regulate metabolism, growth, electrolyte and mineral homeostasis, glucose homeostasis, stress physiology and reproductive function. It also prepares a student for postgraduate studies in any course related to molecular medicine.

### Learning outcomes

On successful completion of the course, students will be able to:

- Explain the molecular mechanism and signaling pathways mediating Hormone Action
- Describe the physiological role of each hormone in regulating growth, appetite, metabolism and reproduction
- Examine the regulatory mechanisms regulating Hormone secretion and release.
- Discuss the basis of endocrine diseases taking case studies.

## DSE-12: GENE ORGANIZATION, REPLICATION AND REPAIR

### Learning Objectives

The objective of the course is to introduce to the students, the basic concepts of genome, DNA structure, genes, chromatin and chromosomes. It provides an understanding of DNA replication, recombination, mutations and repair processes in a way that students can apply this knowledge in understanding the life processes and develop an interest to pursue high quality research.

**Learning outcomes**

On successful completion of the course, students will be able to:

- Analyse the structure of DNA and various forms of DNA and lcarn about organisation of genome in various life forms, supercoiling of DNA and its significance
- Perform isolation of DNA and analyse the purity of isolatcd DNA sample
- Evaluate the molecular basis of processes like DNA replication, recombination and transposition and demonstrate the significance of these processes
- Perform various methods of DNA estimation
- Discuss the various ways in which the DNA can be damaged leading to mutations, lesions and repair mechanisms

**SEMESTER -V**

**Concepts in Genetics (BCH C-11)**

**Course Objectives:**

The aim of the course is to provide students with an understanding of both elassical and modern concepts in genetics with special emphasis on the areas of transmission genetics, molecular and developmental genetics, mapping techniques, chromosomal aberrations and population genetics. Students will gain a hands-on training experience of culturing and conducting experiments on the genetic model system Drosophila mnelanogaster. The course also works as preparation for further studies in a Master's programme in molecular biology or related topics.

**Course Learning Outcomes:**

On successful completion of the course, the students will be:

- Understanding the principles of Mendelian genetics, extensions and applications
- Learning and appreciating the various factors that confer genotypic and phenotypic variability.
- Using the concepts of bacterial and viral genetics to understand resistance patterns and to create linkage and genetic maps.
- Able to use statistical tools to analyze biological data.
- Able to apply the principles of transmission and inheritance in real life situations.

**Gene Expression and Regulation (BCH C-12)**

**Course Objectives:**

The objective of the course is to introduce to the students the basic knowledge about how genes are transcribed and how translation takes place in prokaryotes and eukaryotes and how these processes are regulated, so that students can apply this knowledge in enhancing their analytical and problems solving skills.

**Course Learning Outcomes:**

After completion of the course students will:

acquire basic knowledge about the processes of transcription and translation in prokaryotes and eukaryotes learn about the features of the genetic code and various experimental approaches used to crack the code develop understanding of the molecular basis of RNA processing and RNA splicing learn about the various ways in which these biological processes are regulated and the significance of regulation in maintaining life forms

**Genetic Engineering and Biotechnology (BCH C-13)**

**Course Objectives:**

The objective of the course is to teach the basics of theoretical and practical aspects of recombinant DNA technology and various techniques for DNA manipulation in prokaryotes and eukaryotes. Applications of these techniques in production of recombinant therapeutic proteins and vaccines will also be outlined in this course.

**Learning Outcomes:**

The students will be able to understand: The process for isolation and engineering of DNA using restriction and modification enzymes. Use of cloning and expression vectors. The methods for creation of genomic and DNA libraries, their applications and use. Understanding the methods for protein production and their application in industrial production systems.

**SEMESTER-VI**

**Immunology (BCH C-14)**

**Course Objectives:**

This course describes the molecular and cellular basis of the development and function of the immune system. The course will provide the basic framework in immunology that will cover the major topics including innatc and adaptive immunity, antibodies and antigens, the molecular events leading to the generation of antibody, humoral and cell mediated adaptive immune response, hypersensitivity, self-tolerance, autoimmunity and vaccines.

**Course Learning Outcomes:**

Upon completion of this course, a student will be able to:

- Trace the history and developments in immunology.
- Have an overview of the immune system including cells, organs and receptors.

- Describe the basic mechanism, differences and functional interplay of innate and adaptive immunity
- Understand Antigens & its Recognition, antigen processing and presentation
- Understand the structure & functions of different classes of Immunoglobulins, and
- understand the genetic basis of antibody diversity
- Define the cellular and molecular pathways of humoral and cell-mediated immune responses
- Describe the mechanisms involved in different types of hypersensitivity
- Explain the principles of tolerance and autoimmunity
- Understand Immunotherapies and basic concept of Vaccines

**Advanced Cell Biology (BCH DSE-2)**

**Course Objectives:**

The course aims to provide advanced knowledge of the function of cellular organelles, the structure and function of cytoskeleton and its role in motility. The course will also provide details of cellular interaction with cells and tissues around and the molecular regulation of cell growth and cell death. The course will outline the molecular details of the origin of cancer and the diagnosis and treatment.

**Course Learning Outcomes:**

The learning outcomes will be as follows:

- Students will develop understanding of the principle and application of some of the classical and advanced cell biology techniques
- Students will be able to describe the role of organelles in the secretion of mature proteins
- and key role of the cytoskeleton in the living cell.

- Students will be able to understand the factors regulating nitosis, meiosis, apoptosis and
- necrosis. They will also be able to comprehend the role and therapeutic value of stem
- cells.
- Students will be able to understand the genetic basis of development of cancer, the molecular diagnosis and molecular drugs which are used for chemotherapy.

**Microbiology (BCH DSE-3)**

**Course Objectives:**

The objective of the course is to trace the history of development of the discipline of Microbiology and to emphasize thc existence of the immense diversity in the microbial world and maintenance of microbes under laboratory conditions. The course also aims to make the students aware of both pathogenic as well as beneficial microbes to prepare students for higher education in microbiology-related disciplines.

**Course Learning Outcomes:**

On succcssful completion of this paper,

- Students should be able to: Identify different microbes
- Perform routince microbiological practices including sterilization, media preparation,
- maintenance of microbial culture, staining etc.
- Carry out research using microbes.
- Test microbial culture for antibiotic resistance

**Molecular Basis of Infectious Disease (BCH DSE-4)**

**Course Objective:**

The course aims to provide knowledge about various microbial infectious agents that cause discases in humans, the concepts of treatment and the biochemical basis of mechanism of action

and drug resistance for various antimicrobial agents. The course will also provide outline of the various strategies that are employed for preventing infectious diseases and the role of vaccination in eradication of diseases. It will cover the concept of emergence and reemergence of discases and idea of bio-terrorism and its impact worldwide. The course will also summarize the significance of hygiene, sanitation, drugs and vaccination in prevention and eradication of infectious diseases.

**Course Learning Outcomes:**

- Students will understand various classes of pathogens and their mode of action and transmission.
- Students will be exposed to molecular basis of treatment, diagnosis and vaccine design
- strategies for all the diseases listed.
- Students will gain insight into host immune responses that ensue subsequent to infection.
- Students will learn the details of diseases such as tuberculosis, AIDS and malaria which are
- highly prevalent in Indian subcontinent.

**Advanced Methodologies (BCH DSE-6)**

**Course Objective:**

The objective of the course is to provide students with a sound background of latest techniques used in biochemistry research and to provide them with an understanding of the principles underlying these techniques. The course is designed to impart laboratory skills in the form of practical exercises so that students can apply this knowledge to augment their research acumen and improve their understanding of the subject.

**Learning Outcomes**

- Students will acquire knowledge about the principles and applications of latest methods used to analyze nucleic acids and proteins.
- Students will learn about the principle and applications of microscopy and various cell biology
  techniques.
- Students will also be exposed to various methods of labeling DNA, proteins and whole cells and their applications in research.
- The course will also provide them an opportunity for hands-on cxpcricnce to develop their laboratory skills expected of any biochemist working in a research lab.