

**Department/ Centre/ Directorate: Clinical Biochemistry.**

**Strategic curriculum design: aligning with local, national, and global developmental demands, emphasizing learning objectives and comprehensive outcomes in university programs, with a special focus on diagnostics, clinical laboratory advancements, and clinical pathology excellence.**

### **Biomolecules-I: Biochemistry and Disorders**

#### **Objectives:**

1. Grasp cell bioenergetics principles, emphasizing ATP and thermodynamics in cellular processes.
2. Explore carbohydrates, covering structure, metabolism, and related disorders.
3. Examine lipids for composition, metabolism, and associated disorders.
4. Delve into nucleic acids, understanding structure, metabolism, and disorders like gout and enzyme disorders.

#### **Outcomes:**

1. Master fundamental concepts of cell bioenergetics and its role in cellular activities.
2. Analyze and comprehend carbohydrates' structural intricacies, metabolic pathways, and associated disorders.
3. Understand lipid composition, metabolism, and their relevance to cellular structures, functions and associated disorders.
4. Gain advanced knowledge of nucleic acids, recognizing their structure, metabolic functions, and associations with specific disorders, contributing to a comprehensive understanding of cellular biochemistry.

### **Biomolecules-II: Biochemistry & Disorders**

This advanced course delves into the intricacies of proteins, unraveling their composition, structures, and metabolism. Explore the clinical dimensions of protein disorders, from plasma proteins to folding anomalies linked to conditions like Alzheimer's. Master the art of enzymes, from classification to diagnostic applications, unlocking a world of cutting-edge skills essential for a stellar journey in biochemistry.

### **Clinical Genetics**

Explore clinical genetics, unraveling the intricacies of inheritance, Mendelian laws, and gene mapping. Delve into real medical scenarios with case studies, mastering the genetic basis of disorders like Cystic Fibrosis and Tay-Sach's Syndrome.

### **Lab course-I**

In Lab Course I, students immerse themselves in basic hands-on biochemical applications, mastering pH and buffer concepts. From qualitative analyses of carbohydrates, amino acids, and lipids to advanced techniques like chromatography, they develop skills in protein and glucose quantification. The course extends to essential microbiological practices, exploring sterilization techniques, culture media preparation, and bacterial growth studies. With real-world applications like enzyme extraction and assay, students gain practical expertise vital for a successful laboratory career.

### **Cell Biology**

In Cell Biology, students explore the evolution of cells, membrane structures, and the dynamics of cell organelles. From lipid bilayers to cytoskeleton functions, they gain insights into cellular architecture. Real-world applications include studying membrane disorders, molecular mechanisms of vesicular transport, and the role of cytoskeleton in cell migration. This course equips students for impactful contributions in cellular research and biotechnology.

### **Biophysical Techniques**

In Biophysical Techniques, students master the principles of UV/Visible, Fluorescence, Circular Dichroism, and Mass Spectrometry spectroscopy. They gain expertise in protein separation through chromatography and HPLC, and learn the intricacies of centrifugation techniques. This course equips students for diverse applications in biophysics and analytical chemistry, fostering practical skills for scientific research and analysis.

### **Molecular Biology**

In Molecular Biology-I, students will learn the history and experimental evidence establishing DNA as the genetic material. They delve into the intricate structures of chromatin and chromosomes, exploring unique and repetitive DNA, heterochromatin, and euchromatin. The course covers denaturation kinetics, extrachromosomal DNA, and the features of the human genome. Students also gain a profound understanding of DNA replication, replicon concept, and the regulation of replication, preparing them for applications in genetic research, biotechnology, and medical advancements.

### **Basic Concepts in Clinical Biochemistry**

In Clinical Biochemistry, students will grasp the foundational concepts and scope of biochemistry in diagnostics. They will learn the intricacies of collecting and preserving biological fluids, understanding normal values in blood, CSF, and urine. The course goes further to cover basic requirements for a clinical laboratory, emphasizing sample collection, preparation, preservation, and quality control. Additionally, students will explore the clinical significance of biomolecules, focusing on glucose and lipid profiles, and their role in disorders like diabetes and atherosclerosis. This knowledge prepares them for a pivotal role in healthcare diagnostics and research.

## **SEMESTER-II**

### **Molecular Biology-II**

In Molecular Biology-II, students will delve into the intricacies of gene structure and organization, exploring the historical perspective of the 'one gene, one enzyme' hypothesis and deciphering codons. They will gain insights into prokaryotic gene fine structure, operon concepts, and gene organization in eukaryotes, including the complexities of interrupted genes, exons, and introns. The course further covers gene expression and regulation, unraveling transcription processes, RNA processing, and protein synthesis. Students will also explore the pivotal role of molecular diagnostics in the contemporary diagnostic landscape, learning essential techniques and applications in the diagnosis of diseases like HIV, tuberculosis, cholera, and pathogenic E. Coli. This knowledge prepares students for cutting-edge advancements in molecular biology and diagnostic technologies.

### **Clinical Immunology**

In Clinical Immunology, students will have a comprehensive exploration, beginning with the historical development of immunology and delving into innate and adaptive immunity. They will study the cells of the immune system, including phagocytic cells, B & T lymphocytes, NK cells, and dendritic cells, understanding humoral and cell-mediated immune responses. The course extends to the intricacies of immunoglobulin structure and function, emphasizing sequencing studies and the role of immunoglobulin classes. Students will explore autoimmune disorders, hypersensitivity reactions, and immune responses during infections, gaining insights into treatments and clinical manifestations. Additionally, transplantation immunology will be covered, including the basis of graft rejection, mechanisms, clinical manifestations, and immunosuppressant therapies, preparing students for roles in clinical transplantation and immunological research.

### **Microbiology**

In Microbiology, students explore microbial systems, learning the significance of microbiology in human health and the environment. The curriculum covers microbial

growth, classification, pure culture techniques, and microbial fermentation. Basic Medical Microbiology delves into infectious diseases, their sources, transmission, and pathogenesis. Students study virulence factors, treatment, and prevention of microbial infections, focusing on pathogens like Staphylococci, Salmonella, Shigella, and Clostridium, gaining a robust foundation to address microbial challenges.

### **Lab Course-II**

In Lab Course-II, students will engage in hands-on experiences crucial for molecular biology and microbiology. They will master techniques such as isolating bacterial and plasmid DNA, preparing genomic DNA from plant tissue and blood samples, and determining the qualitative and quantitative aspects of DNA and RNA. Additionally, students will explore the absorption spectra of nucleic acids, conduct denaturation studies, and gain proficiency in techniques like agarose gel electrophoresis, polyacrylamide gel electrophoresis (PAGE), SDS-PAGE, and DNA segment amplification using PCR. This lab course provides practical skills essential for various applications in genetic research, diagnostics, and biotechnology.

### **Techniques in Cell & Molecular Medicine**

In Techniques in Cell & Molecular Medicine, students will delve into the intricacies of molecular biology and radiolabeling methods, mastering DNA purification from various sources and advanced electrophoresis techniques. The curriculum includes recombinant DNA methods, covering molecular cloning, expression of recombinant proteins, and gene manipulation in bacterial and eukaryotic systems. Applied molecular biology methods explore protein and DNA sequencing, genome sequencing strategies, and large-scale expression analysis using dot-blotting and microarray techniques. The course also covers diverse PCR techniques, blotting methods (Southern, northern, and western), and advanced microscopic techniques, providing students with a comprehensive skill set for applications in genetic research, diagnostics, and medical imaging.

### **Cell Signaling and Disorders**

In Cell Signaling and Disorders, students will explore the fundamentals of signal transduction, covering cell-surface receptors, intracellular receptors, and pathways controlling gene expression. They will gain insights into critical signaling pathways like JAK-STAT and MAPK, understanding hormone response elements and secondary messengers. The course also addresses disorders related to cell surface receptors, G-protein defects, and mutations in signaling molecules linked to cancer, providing a profound understanding of cellular communication and its implications in health and disease.

### **Cell cycle and cancer biology**

In Cell Cycle and Cancer Biology, students will explore the intricacies of cell division and the cell cycle, delving into stages, checkpoints, and regulatory factors governing mitosis and meiosis. The course extends into Cancer Biology, covering the development, causes, and properties of cancerous cells. Students will study tumor viruses, oncogenes, and tumor suppressor genes, understanding their roles in signal transduction. With a focus on diagnosis, prevention, and treatment of cancer, this course equips students with knowledge essential for research and diverse avenues in the field of oncology.

### **Protein Biophysics**

In Protein Biophysics, students will explore the fascinating world of peptide conformation, covering aspects such as cis and trans conformation, Ramachandran Plot, and various structural elements. The course delves into Protein Folding, addressing the intricacies of Levinthal's Paradox, folding models, and the folding funnel hypothesis. Students will also study protein misfolding, including the formation of amyloid fibrils and factors influencing aggregation, offering insights crucial for research and diverse applications in the field of biophysics and their role in protein misfolding diseases.

### **Life style diseases and laboratory diagnosis**

In 'Lifestyle Diseases and Laboratory Diagnosis,' students will explore the intricacies of cardiovascular diseases, delving into types, risk factors, and prevention strategies. The course covers lifestyle-related health issues such as obesity, diabetes, and their pathological connections, providing insights into inflammatory cascades and effective treatments. In the Laboratory Diagnosis section, students will gain expertise in essential tests, including Lipid Profile, Blood Glucose, Kidney and Liver Function Tests, hormone tests, and cancer markers. This knowledge is vital for a comprehensive understanding of lifestyle diseases and their diagnosis, offering valuable skills for research and clinical applications.

## **SEMESTER-III**

### **Respiratory and Excretory Organ systems: Physiology and Diseases**

In 'Respiratory and Excretory Organ Systems: Physiology and Diseases,' students delve into acid-base balance, exploring water and electrolyte regulation, kidney function, and hormonal influences. The respiratory physiology section covers gas diffusion, respiratory diseases investigation, and clinical insights into conditions like COPD, cystic fibrosis, asthma, and pneumonia. The kidney physiology segment elucidates nephron anatomy,

urine formation, and various kidney function tests, providing a comprehensive understanding of glomerular and tubular functions. Students gain expertise in diagnosing and researching conditions such as glomerulonephritis, nephritic syndrome, nephrotic syndrome, and renal failure, making this course vital for those pursuing research and diagnosis in the field.

### **Gastrointestinal and Hepatobiliary Organ systems: Physiology and Diseases**

In 'Gastrointestinal and Hepatobiliary Organ Systems: Physiology and Diseases,' students explore the intricacies of gastric secretion, gastrointestinal hormones, and disorders of the stomach, including peptic ulcer and neoplastic diseases. The course delves into pancreatic function, enzyme assessment, and disorders like acute and chronic pancreatitis. Students gain insights into intestinal function, malabsorption tests, and disorders such as gluten intolerance, inflammatory bowel disease, and Crohn's disease. The hepatobiliary system section covers liver anatomy, biochemical indices in hepatobiliary disorders, and liver function tests, offering a comprehensive understanding of acute and chronic liver diseases. This course equips students with essential knowledge for research and diagnostic applications in the field.

### **Neuromuscular and Skeletal Systems: Physiology and Diseases**

In 'Neuromuscular and Skeletal Systems: Physiology and Diseases,' students explore the intricacies of musculo-skeletal physiology, including the ultrastructure and molecular mechanisms of contraction in skeletal and smooth muscles. The course covers joint physiology, types of joints, synovial fluid properties, and pathophysiology of joint disorders like Osteoarthritis and Rheumatoid Arthritis. Additionally, students delve into bone metabolism, understanding biochemical markers of bone turnover and their significance. The study of nervous system physiology includes nerve impulse transmission, neurotransmitters, neuromuscular junction events, and disorders like Alzheimer's, Parkinson's, epilepsy, and psychiatric disorders. This comprehensive course provides students with essential knowledge for research and diagnostic applications in the field.

### **Lab Course-III**

In 'Lab Course-III,' students embark on a hands-on journey through diverse diagnostic techniques. They learn the estimation of serum biomarkers such as albumin, lipids, bilirubin, and enzymes like ALT and AST. The course covers urine analysis, subcellular fractionation, and marker enzyme activities. Students delve into hemoglobin analysis, thyroid function tests, and autoimmune markers like antinuclear antibodies. The lab extends to separation techniques, TLC/DLC, and electrolyte estimation. Practical demonstrations include PCR variants (RFLP, RT-PCR/Q-PCR), emphasizing diagnostic applications. The comprehensive range of tests spans liver and biliary tract, renal diseases,

and various biochemical analyses. This lab course equips students with essential diagnostic skills for diverse medical scenarios.

## **SEMESTER-IV**

### **Dissertation/Internship**

As part of our commitment to fostering holistic development and real-world readiness, we offer an unparalleled opportunity for our students to immerse themselves in hands-on training and cutting-edge research during their fourth semester internship. At the Department of Clinical Biochemistry, we believe in transcending traditional boundaries of learning. Our students have the unique privilege of undertaking their dissertation work in some of India's most esteemed institutions (AIIMS, IISc, TIFR, NCBS, ICGEB, NII, JNU, IITS etc.) where innovation is the norm and breakthroughs are a part of daily life.

During their internship, they are exposed to a plethora of techniques encompassing the realms of biology and molecular biology. From mastering the intricacies of genetic manipulation to unraveling the mysteries of cellular processes, the students acquire skills that are not just theoretical but deeply rooted in practical application. But it's not just about acquiring knowledge – it's about transforming it into action. Our internship program is meticulously designed to provide you with a platform to apply your learning in real-world scenarios, under the guidance of seasoned professionals and researchers. Whether they aspire to pursue a career in academia, research, or the clinical sector, the experiences gained here will undoubtedly shape their future trajectory.

Moreover, our department prides itself on fostering a nurturing and collaborative environment. Here, they are part of a vibrant community of scholars and mentors who are dedicated to their success. Through peer-to-peer learning, interdisciplinary collaboration, and mentorship, students can not only expand their academic horizons but also forge lifelong connections that transcend the boundaries of the classroom.