

**FACULTY OF SCIENCE  
DEPARTMENT OF BIOCHEMISTRY & BIOTECHNOLOGY**

**M.Sc. Biotechnology (Five Year Integrated) Programme**

**19IBTT14 Fundamentals of Biochemistry**

**Course Outcomes:**

- CO1: Understand the concept of pH, acids, bases and buffers and discuss the orders of protein structure, properties and functions in detail.
- CO2: Know how simple precursors give rise to large molecules like protein carbohydrates, lipids and nucleic acids.
- CO3: Classify lipids and understand their biological functions
- CO4 : Describe the structures of purines and pyrimidines, the organization of nucleic acids and different structural forms of DNA and properties.
- CO5: Understand the biological functions of vitamins and correlate with the deficiency states.
- CO6: Understand the characteristics of enzymes.

**19IBTT24 Basic Cell Biology and Genetics**

**Course Outcomes:**

- CO1: Differentiate prokaryotic and eukaryotic cells.
- CO2 : Understand the organizational and functional aspects of cells and organelles.
- CO3: Learn membrane structure and transport.
- CO4: Learn how cells undergo mitosis and meiosis.
- CO5: Learn the basic concepts of genetics.
- CO6: Understand the chromosomal variation and its effects.

**19IBTP25 Core Practical – I Practicals in Biomolecules, Cell Biology and Genetics**

**Course Outcomes:**

- CO1: Prepare buffers and standard solutions
- CO2 : Perform qualitative analysis of carbohydrates and proteins using colorimetry.
- CO3 : Identify rancid fat by determining acid by determining acid number.
- CO4: Identify and examine plant cells, tissue types and the phases of cell division.
- CO5: Carry out karyotyping chromosomes, differentiate wild type and mutants of *Drosophila*

**19IBTT33 Physiology**

**Course Outcomes:**

- CO1: Enumerate blood cell count
- CO2 : Estimate bleeding, clotting and prothrombin time, haemoglobin and ESR
- CO3 : Prepare serum and plasma from blood
- CO4: Perform qualitative analysis of saliva, bile, gastric juice and urine.
- CO5: Appreciate mammalian physiology visually through computer simulation
- CO6: Understand the methodology for BP and ECG measurement

**19IBTP34 Core Practical – II Practicals in Physiology**

**Course Outcomes:**

- CO1: Enumerate blood cell count
- CO2 : Estimate bleeding, clotting and prothrombin time, haemoglobin and ESR
- CO3 : Prepare serum and plasma from blood
- CO4: Perform qualitative analysis of saliva, bile, gastric juice and urine.
- CO5: Appreciate mammalian physiology visually through computer simulation
- CO6: Understand the methodology for BP and ECG measurement

### **19IBTT43 Bioinstrumentation**

#### **Course Outcomes:**

- CO1: Apprehend the principles and applications of basic instruments in a biochemistry laboratory.
- CO2 : Understand the principles, components and applications of spectroscopy and radioisotope techniques.
- CO3: Learn the principle, procedure and applications of different chromatography techniques.
- CO4: Apply electrophoretic and hybridization techniques for biomolecule separation.
- CO5: Use the principles and applications of microscopy in various biological fields

### **19IBTT44 Basic Immunology**

#### **Course Outcomes:**

- CO1: Specify the lymphoid organs, cells of the immune system and their functions
- CO2 : Apprehend the definition, properties and role of antigens and antibody types and comprehend the role of complement system
- CO3: Understand the genetic mechanism for antibody diversity and know in detail about classical and newer vaccines
- CO4: Understand the immune mechanisms, hypersensitivity and tissue transplantation
- CO5: Describe the function and role of HLA protein and disease association

### **19IBTT45 Core Practical-III Practicals in Bioinstrumentation and Basic Immunology**

#### **Course Outcomes:**

- CO1: Understand basic principles of spectrophotometry
- CO2 : Demonstrate microscopy techniques
- CO3: Perform chromatography techniques
- CO4: Separate macromolecules by agarose gel electrophoresis
- CO5: Identify various types of immune cells and to prepare cell suspension from spleen
- CO6: Understand and perform ELISA technique

### **19IBTT51 Metabolism**

#### **Course Outcomes:**

- CO1: Understand the basic bioenergetic principles and cellular synthesis of ATP
- CO2 : Understand the reaction pathways of glucose and glycogen metabolism
- CO3 : Describe the oxidation and biosynthesis of lipids.
- CO4 : Understand the function of ammonia, metabolic fate of amino acids, synthesis of urea, and generation of intermediates of TCA cycle.
- CO5: Understand the de novo and salvage pathways of purine and pyrimidine metabolism and the concept of metabolomics

### **19IBTT52 Molecular Biology**

#### **Course Outcomes:**

- CO1: Acquire knowledge on the complexity of eukaryotic genome organization.
- CO2: Understand the molecular mechanism of DNA replication.
- CO3: Understand the types of mutation and repair.
- CO4: Understand the transcription in prokaryotes and eukaryotes, post transcriptional processing and  
RNA splicing
- CO5: Assimilate the information flow and steps for protein synthesis and the mechanisms involved.
- CO6: Understand the use of protein synthesis inhibitors and dynamic nature of proteins.

### **19IBTT53 Recombinant DNA Technology**

#### **Course Outcomes:**

- CO1: Gain knowledge about cloning and expression vectors and use of restriction enzymes in construction of vectors
- CO2: Study various expression systems and markers
- CO3: Learn and apply the methods of screening recombinants and construction of genomic and DNA libraries.
- CO4: Learn about gene transfer mechanisms and transgenesis in plants and animals
- CO5: Describe the principle and applications of versatile techniques in molecular biology such as DNA sequencing, DNA finger printing and PCR.

### **19IBTP55 Core Practical– IV Practicals in Metabolism, Molecular Biology and rDNA Technology**

#### **Course Outcomes:**

- CO1: Demonstrate cellular respiration in yeast
- CO2: Isolate and quantitatively analyze DNA and RNA from bacteria and yeast.
- CO3: Differentiate chromosomal and plasmid DNA
- CO4: Demonstrate chromosome/gene transfer in bacteria by conjugation and transformation.
- CO5: Analyze the properties of DNA like molecular size, light absorption, thermal denaturation, and restriction enzyme digestion.
- CO6: To perform restriction enzyme digestion of DNA

### **19IBTT61 Cell and Tissue Culture**

#### **Course Outcomes:**

- CO1: Acquire knowledge on organization of cell and tissue culture lab and methods of aseptic maintenance and nutritional requirements.
- CO2: Learn techniques for culturing animal cell line and cloning of cell lines.
- CO3: Understand the types of animal cell culture.
- CO4: Understand the techniques employed for plant tissue culture including single cell, protoplast and callus culture.
- CO5: Appreciate the commercial applications of plant and animal tissue culture in breeding and industry.

### **19IBTT62 Pharmaceutical Biotechnology**

#### **Course Outcomes:**

- CO1: Understand the scope of pharmaceutical biotechnology.
- CO2: Understand pharmacokinetics, metabolism and dynamics of drugs
- CO3: Apply the manufacturing principles in formulation of drugs and biopharmaceuticals.
- CO4: Comprehend the production of recombinant proteins, enzymes and carbohydrate and nucleic acid based biopharmaceuticals.
- CO5: Explain the regulatory aspects in drug development and drug approval
- CO6: Understand the steps in drug discovery process

### **19IBTT63 Bioprocess Technology**

#### **Course Outcomes:**

- CO1: Exhibit knowledge on the industrially important microorganisms, their growth, isolation, screening and inoculum preparation.
- CO2: Understand and apply the methodology, requirements for different types of fermentation.
- CO3: Learn the steps in downstream processing from product isolation to packaging
- CO4: Apprehend the use of biotechnology for production of high value compounds
- CO5: Know the principles and applications of bioprocessing, metabolic engineering and SCP production

### **19IBTT64 Biotechnology and Human Welfare**

#### **Course Outcomes:**

- CO1: List some applications of biotechnology in wide domains of biological sciences.
- CO2: Explain the technology for development of biotechnology product.
- CO3: Understand and solve biomedical and biological problems using biotechnology
- CO4: Understand the technology used in forensic medicine and tissue engineering.
- CO5: Comprehend the applications of stem cell technology, gene therapy and nanobiotechnology

### **19IBTP65 Core Practical – V Practicals in Cell Culture, Pharmaceutical Biotechnology and Bioprocess Technology Hours**

#### **Course Outcomes:**

- CO1: Learn the basic techniques like staining and identification of cell culture using microscope and media preparation and sterilization.
- CO2 : Evaluate cell division through mitotic index.
- CO3 : Analyze the antioxidant properties of important drugs.
- CO4: Learn the immobilization of yeast/microbes
- CO5: Determine the growth curve, growth rate, yield and hydrolytic activity of microorganisms.
- CO6: Comprehend microbial production of compounds of commercial importance.

### **19IBTT71 Biomolecules and Metabolism**

#### **Course Outcomes:**

- CO1: Know the structural organization of proteins and understand the terms domains and motifs in describing protein structure.
- CO2: Understand the basic and alternate structural forms of DNA, types of RNA and their functions.
- CO3: Identify the motifs by which proteins interact with DNA
- CO4: Apprehend the significance of major glycoconjugates, the biological functions of lipids and the composition of lipoproteins.
- CO5: Describe the anabolic and catabolic reactions of major biomolecules.

### **19IBTT72 Molecular Cell Biology**

#### **Course Outcomes:**

- CO1: Differentiate prokaryotic and eukaryotic cells.
- CO2: Understand the organizational and functional aspects of cells and organelles.
- CO3: Learn cell-cell communication as well as interaction with outside environment through transport of molecules.
- CO4: Learn how cells respond to external stimuli through the signal transduction mechanisms.
- CO5: Appreciate the molecular events involved in cell division, cell cycle and cell death.

### **19IBTT73 Enzyme Technology**

#### **Course Outcomes:**

- CO1: Understand the basic concepts and the kinetics and regulatory role of enzymes.
- CO2: Comprehend the methods for enzyme production and immobilization
- CO3: Design the strategies of enzyme engineering
- CO4: Apply the methods for large scale isolation, purification and downstream processing of enzymes
- CO5: Apprehend the applications of enzymes as tools in industry and as therapeutics in medicine.

### **19IBTP74 Core Practical – VI Practicals in Biomolecules, Cell Biology and Enzyme Technology Course Outcomes:**

- CO1: Analyze amino acids by qualitative and quantitative methods.

- CO2: Estimate nucleic acid by chemical methods.
- CO3: Identify and examine plant cells, tissue types and the phases of cell division.
- CO4: Evaluate the factors affecting enzyme activity and immobilize enzymes.

### **19IBTT81 Applied Microbiology and Immunotechnology**

#### **Course Outcomes:**

- CO1: Understand the classification of microorganisms and principles of staining.
- CO2: To know about disease transmission, antimicrobial agents and food sanitation
- CO3: Apprehend the importance of immunization practices and the development of novel vaccines.
- CO4: Interpret the association of immune system with cancer, AIDS, autoimmunity and transplantation.
- CO5: Demonstrate techniques involving antigen-antibody reactions and learn their biological applications.

### **19IBTT82 Advanced Molecular Biology**

#### **Course Outcomes:**

- CO1: Comprehend genome complexity and the steps in replication
- CO2: Appreciate repair mechanisms and the consequences of DNA mutations and recombination.
- CO3: Figure out the steps in transcription and the significance of post transcriptional processing
- CO4: Gain in-depth knowledge on genetic code, mechanism of protein synthesis and protein sorting.
- CO5: Understand the mechanism involved in gene expression regulation at transcriptional, translational and epigenetic levels.

### **19IBTT83 Genetic Engineering**

#### **Course Outcomes:**

- CO1: Understand the concept of cloning, expression of desired genes, and construction of genomic library.
- CO2: Apply genetic engineering principles to perform gene expression analysis and gene manipulation.
- CO3: Understand the principles and applications of RACE, RAPD and PCR.
- CO4: Apply the knowledge on expression of cloned genes for basic and applied research.
- CO5: Comprehend the steps and applications of protein and metabolic engineering.

### **19IBTP84 Core Practical – VII Practicals in Immunotechnology, Molecular Biology and Genetic Engineering**

#### **Course Outcomes:**

- CO1: Perform and interpret immunodiffusion and immuno electrophoresis.
- CO2: Isolate and analyze nucleic acids from various sources.
- CO3: Separate proteins in a biological sample by SDS-PAGE and study protein abundance by western blotting.
- CO4: Identify blood groups and Rh factor
- CO5: Undertake PCR analysis and know about real time qPCR

### **19IBTT91 Analytical Techniques and Nanobiotechnology**

#### **Course Outcomes:**

- CO1: Understand the principle, components and applications of spectroscopic and radioisotope techniques.
- CO2: Learn the principle, procedure and applications of different chromatographic techniques.
- CO3: Apply electrophoretic and hybridization techniques for biomolecule separation.
- CO4: Apply the techniques of sedimentation and microscopy for research.

CO5: Understand the concept of nanobiotechnology and apply the scientific knowledge for solving problems in biology and medicine.

#### **19IBTT92 Industrial and Environmental Biotechnology**

##### **Course Outcomes:**

CO1: Understand types of bioreactors, fermentation process and bioprocessing.

CO2: Know the requirements for successful operation of downstream processes for production of biopharmaceuticals.

CO3: Apprehend the harmful effects of pollution and biotechnological measures for pollution control.

CO4: Apply biotechnological process in waste management, cleanup of environment and agricultural improvement.

CO5: Comprehend the fundamentals of biodegradation, biotransformation and bioremediation and apply biotechnological innovation in conservation.

CO6: Recognize the importance of renewable energy sources and green technology.

#### **19IBTT93 Plant Biotechnology**

##### **Course Outcomes:**

CO1: Understand and learn the techniques for culturing tissues, single cell, protoplast and anther culture and adopt methods of sterilization and cryopreservation

CO2: Learn gene transfer methods and molecular marker assisted selection.

CO3: Evaluate the production and benefits of genetically modified plants.

CO4: Apply rDNA technology for crop improvement.

CO5: Recognize the importance of protection of new knowledge and patenting of innovations in research.

#### **19IBTT94 Animal Biotechnology**

##### **Course Outcomes:**

CO1: Understand the fundamental principles that underlie cell culture and carryout cell based assays.

CO2: Comprehend the steps in manipulation of reproduction and acquire knowledge in animal cloning.

CO3: Understand the methods of gene transfer in animals.

CO4: Comprehend the methods of producing transgenic animals and benefits of transgenesis and related issues.

CO5 Recognize the importance of biosafety practices, ethical guidelines for research and entrepreneurship skill development.

#### **19IBTT95 Core Practical – VIII (Practicals in Analytical Techniques, Nanobiotechnology, Industrial and Environmental Biotechnology and Animal Biotechnology)**

##### **Course Outcomes:**

CO1: Learn the separation of proteins and biological compounds using electrophoresis and chromatography.

CO2: Assess drinking water purity and microbial abundance in sewage samples.

CO3: Synthesize nanoparticles and immobilize microbial cells.

CO4: Undertake chromosomal studies and test viability of lymphocyte preparation.

CO5 Culture cells in vitro and perform cell based assays.

### **19IBTT101 Food and Medical Biotechnology**

#### **Course Outcomes:**

CO1: Understand the factors influencing food spoilage and apply traditional and modern methods of food preservation.

CO2: Apprehend the uses of fermented foods, enzymes in food industries and concepts in food safety laws and standards.

CO3: Understand the risk factors and molecular aspects of human diseases.

CO4: Use diagnostic kits for screening diseases

CO5: Know the various new therapeutic approaches like nanotherapy, gene therapy and stem cell therapy and related ethical issues

### **19IBTT102 Genomics, Proteomics and Bioinformatics**

#### **Course Outcomes:**

CO1: Understand types of gene map, molecular markers and classical and new generation genome sequencing approaches.

CO2: Comprehend genome projects, post-genome analysis and ELSI

CO3: Apply the modern methods for separation, identification, quantitation and structural analysis of proteins

CO4: Apply structural bioinformatics tools to predict and elucidate protein structures and map protein interactions.

CO5: Retrieve, align, analyze and interpret sequence and structural data from databases.

CO6: Construct the phylogenetic tree of different sequences and apply database information for molecular modelling.

### **19IBTP103 Core Practical – IX (Practicals in Bioinformatics, Food and Medical Biotechnology)**

#### **Course Outcomes:**

CO1: Retrieve, align and analyze protein and nucleic acid sequences and structures

CO2: Adopt appropriate tools to model and visualize proteins

CO3: Acquire skills for preservation of foods and to check food quality

CO4: Quantitatively analyze blood parameters of clinical importance and acquire skills in histology

CO5: Gain and insight into the handling of ELISA, HPTLC, autoanalyser, 2D-PAGE, NMR and XRD.

### **19IBTA15 Ancillary Offered to Other Departments Biochemistry- Paper I**

#### **Course Outcomes:**

CO1: Understand the bioenergetics principles.

CO2: Understand the classification, nomenclature, kinetics, inhibition and applications of enzymes

CO3: Learn the classification, properties of carbohydrate and understand their biological functions.

CO4: Understand the biochemistry of amino acids and proteins.

CO5: Know the composition of various types of lipids, their biological functions and membrane structure.

CO6: Understand the metabolic reaction of carbohydrates, proteins and lipids.

### **19IBTA26 Biochemistry-Paper II**

#### **Course Outcomes:**

CO1: Understand the nutritional and biochemical aspects of vitamins and minerals.

CO2: Learn the structure and functions of nucleic acids.

CO3: Understand the process of DNA replication, damage and repair and the transcription

CO4: Gain knowledge on the phases of translation and fundamental aspects of recombinant DNA technology

CO5: Understand the clinical conditions arising from malnutrition, over nutrition and in born errors in metabolism and biochemical basis of diabetes mellitus, atherosclerosis and jaundice

### **19IBTP27 Biochemistry Practical (Ancillary)**

#### **Course Outcomes:**

CO1: Prepare reagents and buffers

CO2: Analyze quantitatively / qualitatively carbohydrates, amino acids, and proteins.

CO3: Determine the characteristics of fatty acids in oil samples.

CO4: Analyze the concentration of glucose and cholesterol in biological samples.

CO5: Isolate and estimate DNA and RNA concentrations in biological samples.

### **19IBTTE16.1 Biofertilizers**

#### **Course Outcomes:**

CO1: Discuss the types and importance of biofertilizers

CO2: Know the isolation and mass multiplication of Azospirillum

CO3: Describe the types and characteristics of cyanobacteria

CO4: Understand the types and importance of mycorrhizal association

CO5: Understand the risk factors and significance of organic agriculture

### **19IBTTE16.2 Evolutionary Biology**

#### **Course Outcomes:**

CO1: Discuss the Pre-Darwinian ideas

CO2: Know the evidences of evolution

CO3: Describe the sources and forces of evolution

CO4: Understand the evolution of fungi and plants

CO5: Understand the evolution of humans

### **19IBTTE16.3 Public Health and Management**

#### **Course Outcomes:**

CO1: Discuss the sources and causes of environmental hazards

CO2: Know the types, causes, sources and prevention of pollution

CO3: Describe the types and characteristics of wastes and disposal

CO4: Understand the social and economic factors of communicable diseases

CO5: Understand the risk factors, symptoms and treatment of non-communicable diseases.

### **19IBTTE36.1 Natural Resource Management**

#### **Course Outcomes:**

CO1: Understand the natural resources and sustainable utilization

CO2: Apprehend the utilization of land and water

CO3: Understand the biological resources and forests

CO4: Understand the renewable and non-renewable sources of energy

CO5: Describe the contemporary practices in resource management

### **19IBTTE36.2 Animal Behaviour and Chronobiology**

#### **Course Outcomes:**

CO1: Understand about patterns and mechanisms of behaviour

CO2 : Apprehend the concepts of social behaviour and altruism

CO3: Understand about anatomy and physiology of circadian clocks

CO4: Understand the basic concepts of chronoendocrinology, chronopharmacology and chronotherapy

CO5: Describe the function and role of circadian clock genes in Drosophila and mammals

### **19IBTTE36.3 Plant Biochemistry**

#### **Course Outcomes:**

- CO1: Understand plant cell structure and photosynthesis
- CO2: Apprehend the concepts of respiration in plants
- CO3: Understand about nitrogen metabolism
- CO4: Understand the basic concepts of plant hormones and regulation of plant growth
- CO5: Describe the functions of secondary metabolites

### **19IBTTE55.1 Ecology**

#### **Course Outcomes:**

- CO1: Understand the importance of ecology
- CO2: Understand the concepts in population ecology
- CO3 : Describe the components and types of ecosystem
- CO4 : Understand the salient features of community ecology
- CO5: Understand the fundamentals of behavioural ecology

### **19IBTTE55.2 Biodiversity**

#### **Course Outcomes:**

- CO1: Understand the components of biodiversity
- CO2: Understand the tools in the study of biodiversity
- CO3: Describe the basics of plant diversity
- CO4: Understand the salient features of bio-prospecting
- CO5: Understand the fundamentals of microbial diversity and Overview of methods in taxonomy of bacteria

### **19IBTTE55.3 Wild Life Conservation and Management**

#### **Course Outcomes:**

- CO1: Understand the ethics of wildlife conservation
- CO2: Understand the salient features of habitat analysis
- CO3: Describe the basics of human-wildlife interactions
- CO4: Understand the concepts of management
- CO5: Understand the fundamentals of sustainable wildlife management

### **19IBTTE85.1 Clinical Biochemistry**

#### **Course Outcomes:**

- CO1: Comprehend the genetic diseases
- CO2. Understand the complications and treatment of liver and pancreatic disorders
- CO3. Appreciate the biochemical and molecular basis of cancer and AIDS.
- CO4. Gain knowledge on protein energy malnutrition and obesity.

### **19IBTTE85.2 Basic Endocrinology**

#### **Course Outcomes:**

- CO1: Understand the general characteristics of hormone and hypothalamic and pituitary hormone
- CO2:. Learn the functions of thyroid and parathyroid secretions and disorders associated with hypo and hyper secretions.
- CO3: Gain an understanding of the biological effects of adrenal hormones.
- CO4: Know the hormones of the pancreas and clinical conditions associated with pancreatic insufficiency as well as about GI tract hormones.
- CO5: Understand the gonadal hormone functions and associated clinical conditions.

### **19IBTTE85.3 Developmental Biology**

#### **Course Outcomes:**

- CO1: Understand the basics of embryo development in vertebrates and invertebrates.
- CO2: Learn the events in the early embryonic development.
- CO3: Understand the development of organs and developmental pattern
- CO4: Understand the events taking place during post - embryonic development.
- CO5: Understand the medical implications of developmental biology.

### **19IBTTE96.1 Medical Laboratory Technology**

#### **Course Outcomes:**

- CO1: Perform the basic haematology techniques and undertake biochemical analysis of clinical samples
- CO2: Understand the tests performed in clinical microbiology lab
- CO3: Undertake histological analysis of samples.
- CO4: Comprehend the basic techniques performed in clinical immunology laboratory.
- CO5: Know about quality control, lab accreditation and automation.

### **19IBTTE96.2 Biotechnology Management**

#### **Course Outcomes:**

- CO1: Develop an understanding of the fundamental topics on management.
- CO2: Gain knowledge on business economics and project management.
- CO3: Get a strong foundation on commercialization of biotechnology products.
- CO4: Get the required knowledge to lead and administer biotechnology companies.
- CO5: Undertake entrepreneurship ventures.

### **19BIOX215.1 Interdepartment Electives Offered to Other Departments Basic Biochemistry**

#### **Course Outcomes:**

- CO1: Understand the structure, classification and properties of carbohydrates and amino acids
- CO2: Gain knowledge on the hierarchical organisation and properties of proteins, structure and properties of lipids and nucleic acids
- CO3: Comprehend the functions and kinetic characteristics of enzymes
- CO4: Understand the major metabolic pathways of biomolecules

### **19BIOX215.2 Basic Biotechnology**

#### **Course Outcomes:**

- CO1: Know the principles of bioprocess engineering and downstream processing,
- CO2: Understand the methods applied for waste water treatment and uses of enzymes in industries.
- CO3: Learn the steps involved in cloning and the importance of biofertilizers and biopesticides.
- CO4: Know the basics of food biotechnology and applications of enzymes in food industry.
- CO5: Learn about the production of transgenic plants and animals.

### **19BIOX315.1 Biochemical Techniques**

#### **Course Outcomes:**

- CO1: Understand the basic principle, instrumentation and applications of spectroscopy and
- CO2: Comprehend the principle and application of radioisotope techniques
- CO3: Understand the principle, instrumentation and applications of electrophoresis and blotting
- CO4: Appreciate the principles and applications of chromatography and centrifugation Technique

### **19BIOX315.2 Immunology**

#### **Course Outcomes:**

- CO1. Know the cells and organs of the immune system and about antigens and antibodies
- CO2. Appreciate complement system and types of immunity.
- CO3. Understand vaccination, antibody diversity and transplantation
- CO4. Gain knowledge on immunochemical techniques

## **DEPARTMENT OF BIOCHEMISTRY & BIOTECHNOLOGY**

### **M.Sc. Biotechnology (Two-Year) Programme**

#### **19BITC 101 Biomolecules and Metabolism**

##### **Course Outcomes:**

- CO1: Know the structural organization of proteins and understand the terms domains and motifs in describing protein structure.
- CO2: Understand the basic and alternate structural forms of DNA, types of RNA and their functions.
- CO3: Identify the motifs by which proteins interact with DNA
- CO4: Apprehend the significance of major glycoconjugates, the biological functions of lipids and the composition of lipoproteins.
- CO5: Describe the anabolic and catabolic reactions of major biomolecules.

#### **19BITC 102 Molecular Cell Biology**

##### **Course Outcomes:**

- CO1: Differentiate prokaryotic and eukaryotic cells.
- CO2: Understand the organizational and functional aspects of cells and organelles.
- CO3: Learn cell-cell communication as well as interaction with outside environment through transport of molecules.
- CO4: Learn how cells respond to external stimuli through the signal transduction mechanisms.
- CO5: Appreciate the molecular events involved in cell division, cell cycle and cell death.

#### **19BITC 103: Enzyme Technology**

##### **Course Outcomes:**

- CO1: Understand the basic concepts, kinetics and regulatory role of enzymes.
- CO2: Comprehend the methods for enzyme production and immobilization
- CO3: Design the strategies of enzyme engineering
- CO4: Apply the methods for large scale isolation, purification and downstream processing of enzymes
- CO5: Apprehend the applications of enzymes as tools in industry and as therapeutics in medicine.

#### **19BITP 104: Core Practical – 1 Practicals in Biomolecules, Cell Biology and Enzyme Technology**

##### **Course Outcomes:**

- CO1: Analyze amino acids by qualitative and quantitative methods.
- CO2: Estimate nucleic acid by chemical methods.
- CO3: Identify and examine plant cells
- CO4: Examine different tissue types and the phases of cell division.
- CO5: Evaluate the factors affecting enzyme activity
- CO6: Examine the effect of inhibitor on enzyme activity and immobilize enzymes.

#### **19BITC 201: Applied Microbiology and Immunology**

##### **Course Outcomes:**

- CO1: Understand the classification of microorganisms and principles of staining.

CO2: To know about disease transmission, antimicrobial agents and food sanitation  
CO3: Apprehend the importance of immunization practices and the development of novel vaccines.  
CO4: Interpret the association of immune system with cancer, AIDS, autoimmunity and transplantation.  
CO5: Demonstrate techniques involving antigen-antibody reactions and learn their biological applications.

### **19BITC 202: Advanced Molecular Biology**

#### **Course Outcomes:**

CO1: Comprehend genome complexity and the steps in replication  
CO2: Appreciate repair mechanisms and the consequences of DNA mutations and recombination.  
CO3: Figure out the steps in transcription and the significance of post transcriptional processing  
CO4: Gain in-depth knowledge on genetic code, mechanism of protein synthesis and protein sorting.  
CO5: Understand the mechanisms involved in gene expression regulation at transcriptional, translational and epigenetic levels.

### **19BITC 203: Genetic Engineering**

#### **Course Outcomes:**

CO1: Understand the concept of cloning, expression of desired genes, and construction of genomic library.  
CO2: Apply genetic engineering principles to perform gene expression analysis and gene manipulation.  
CO3: Understand the principles and applications of RACE, RAPD and PCR  
CO4: Apply the knowledge on expression of cloned genes for basic and applied research.  
CO5: Comprehend the steps and applications of protein and metabolic engineering

### **19BITP 204: Core Practical Practicals in Immunotechnology, Molecular Biology and Genetic Engineering**

#### **Course Outcomes:**

CO1: Perform and interpret immunodiffusion and immuno electrophoresis.  
CO2: Isolate and analyze nucleic acids from various sources.  
CO3: Separate proteins in biological samples by SDS-PAGE and study protein abundance by western blotting.  
CO4: Identify blood groups and Rh factor  
CO5: Undertake PCR analysis and know about real time qPCR

### **19BITC 301: Analytical Techniques and Nanobiotechnology**

#### **Course Outcomes:**

CO1: Understand the principle, components and applications of spectroscopic and radioisotope techniques.  
CO2: Learn the principle, procedure and applications of different chromatographic techniques.  
CO3: Apply electrophoretic and hybridization techniques for biomolecule separation.  
CO4: Apply the techniques of sedimentation and microscopy for research.  
CO5: Understand the concept of nanobiotechnology and apply the scientific knowledge for solving problems in biology and medicine.

### **19BITC 302: Industrial and Environmental Biotechnology**

#### **Course Outcomes:**

CO1: Understand types of bioreactors, fermentation process and bioprocessing.  
CO2: Know the requirements for successful operation of downstream processes for production of biopharmaceuticals.

- CO3: Apprehend the harmful effects of pollution and biotechnological measures for pollution control.
- CO4: Apply biotechnological process in waste management, cleanup of environment and agricultural improvement.
- CO5: Comprehend the fundamentals of biodegradation, biotransformation and bioremediation and apply biotechnological innovation in conservation.
- CO6: Recognize the importance of renewable energy sources and green technology.

### **19BITC 303 Plant Biotechnology**

#### **Course Outcomes:**

- CO1: Understand and learn the techniques for culturing tissues, single cell, protoplast and anther culture and adopt methods of sterilization and cryopreservation
- CO2: Learn gene transfer methods and molecular marker assisted selection.
- CO3: Evaluate the production and benefits of genetically modified plants.
- CO4: Apply rDNA technology for crop improvement.
- CO5: Recognize the importance of protection of new knowledge and patenting of innovations in research

### **19BITC 304 Animal Biotechnology**

#### **Course Outcomes:**

- CO1: Understand the fundamental principles that underlie cell culture and carryout cell based assays.
- CO2: Comprehend the steps in manipulation of reproduction and acquire knowledge in animal cloning.
- CO3: Understand the methods of gene transfer in animals.
- CO4: Comprehend the methods of producing transgenic animals and benefits of transgenesis and related issues.
- CO5: Recognize the importance of biosafety practices, ethical guidelines for research and entrepreneurship skill development.

### **19BITP 305 Core Practical – 3 Practicals in Analytical Techniques, Nanobiotechnology, Industrial and Environmental Biotechnology, and Animal Biotechnology**

#### **Course Outcomes:**

- CO1: Learn the separation of proteins and biological compounds using electrophoresis and chromatography.
- CO2: Assess drinking water purity and microbial abundance in sewage samples.
- CO3: Synthesize nanoparticles and immobilize microbial cells.
- CO4: Undertake chromosomal studies and test viability of lymphocyte preparation.
- CO5: Culture cells in vitro and perform cell based assays.

### **19BITC 401 Food and Medical Biotechnology**

#### **Course Outcomes:**

- CO1: Understand the factors influencing food spoilage and apply traditional and modern methods of food preservation.
- CO2: Apprehend the uses of fermented foods, enzymes in food industries and concepts in food safety laws and standards.
- CO3: Understand the risk factors and molecular aspects of human diseases.
- CO4: Use diagnostic kits for screening diseases and understand recent molecular diagnostic methods.
- CO5: Know the new therapeutic approaches like nanotherapy, gene therapy and stem cell therapy and related ethical issues

### **19BITC 402 Genomics, Proteomics and Bioinformatics**

#### **Course Outcomes:**

CO1: Understand types of gene map, molecular markers and classical and new generation genome sequencing approaches.

CO2: Comprehend genome projects, post-genome analysis and ELSI

CO3: Apply the modern methods for separation, identification, quantitation and structural analysis of proteins

CO4: Apply structural bioinformatics tools to predict and elucidate protein structures and map protein interactions.

CO5: Retrieve, align, analyze and interpret sequences and structural data from databases.

CO6: Construct phylogenetic tree of different sequences and apply database information for molecular modelling.

### **19BITP 403 Core Practical – 4 Credits: 6 Practicals in Bioinformatics, Food and Medical Biotechnology**

#### **Course Outcomes:**

CO1: Retrieve, align and analyze protein and nucleic acid sequences and structures

CO2: Adopt appropriate tools to model and visualize proteins

CO3: Acquire skills for preservation of foods and to check food quality

CO4: Quantitatively analyze blood parameters of clinical importance and acquire skills in histology

CO5: Understand the handling of ELISA, HPTLC, autoanalyser, 2D-PAGE, NMR and XRD.

### **Department Electives (DE)**

#### **19BITE 205.1 Developmental Biology**

##### **Course Outcomes:**

CO1: Understand the basics of embryo development in vertebrates and invertebrates.

CO2: Learn the events in the early embryonic development.

CO3: Understand the development of organs and developmental pattern

CO4: Understand the events taking place during post - embryonic development.

CO5: Understand the medical implications of developmental biology.

#### **19BITE 205.2 Clinical Biochemistry**

##### **Course Outcomes:**

CO1: Comprehend the genetic diseases

CO2: Understand the complications and treatment of liver and pancreatic disorders

CO3: Appreciate the biochemical and molecular basis of cancer and AIDS.

CO4: Gain knowledge on protein energy malnutrition and obesity

#### **19BITE 205.3 Basic Endocrinology**

##### **Course Outcomes:**

CO1: Understand the general characteristics of hormone and hypothalamic and pituitary hormone

CO2: Learn the functions of thyroid and parathyroid secretions and disorders associated with hypo and hyper secretions.

CO3: Gain an understanding of the biological effects of adrenal hormones.

CO4: Know the hormones of the pancreas and clinical conditions associated with pancreatic insufficiency as well as about GI tract hormones.

CO5: Understand the gonadal hormone functions and associated clinical conditions.

### **19BITE 306.1 Biotechnology Management**

#### **Course Outcomes:**

- CO1: Develop an understanding of the fundamental topics on management.
- CO2: Gain knowledge on business economics and project management.
- CO3: Get a strong foundation on commercialization of biotechnology products.
- CO4: Get the required knowledge to lead and administer biotechnology companies.
- CO5: Undertake entrepreneurship ventures

### **19BITE 306.2 Medical Laboratory Technology**

#### **Course Outcomes:**

- CO1: Perform the basic haematology techniques and undertake biochemical analysis of clinical samples
- CO2: Understand the tests performed in clinical microbiology lab
- CO3: Undertake histological analysis of samples.
- CO4: Comprehend the basic techniques performed in clinical immunology laboratory.
- CO5: Know about quality control, lab accreditation and automation

### **19BITE 306.3 Drug Design and Drug Development**

#### **Course Outcomes:**

- CO1: Understand the basic concepts of pharmacokinetics
- CO2: Know about mechanism of drug action
- CO3: Gain knowledge concepts on drug designing
- CO4: Understand the technologies used in drug development.
- CO5: Understand the strategies for new drug discovery and regulatory bodies concerned with drug approval

### **Interdepartment Electives Offered to Other Departments**

#### **19BIOX 215.1 Basic Biochemistry**

##### **Course Outcomes:**

- CO1: Understand the structure, classification and properties of carbohydrates and aminoacids
- CO2: Gain knowledge on the hierarchical organisation and properties of proteins, structure and properties of lipids and nucleic acids
- CO3: Comprehend the functions and kinetic characteristics of enzymes
- CO4: Understand the major metabolic pathways of biomolecules

#### **19BIOX 215.2 Basic Biotechnology**

##### **Course Outcomes:**

- CO1: Know the principles of bioprocess engineering and downstream processing,
- CO2: Understand the methods applied for waste water treatment and uses of enzymes in industries
- CO3: Learn the steps involved in cloning and the importance of biofertilizers and biopesticides.
- CO4: Know the basics of food biotechnology and applications of enzymes in food industry.
- CO5: Learn about the production of transgenic plants and animals

#### **19BIOX 315.1 Biochemical Techniques**

##### **Course Outcomes:**

- CO1: Understand the basic principle, instrumentation and applications of spectroscopy and
- CO2: Comprehend the principle and application of radioisotope techniques
- CO3: Understand the principle, instrumentation and applications of electrophoresis and blotting
- CO4: Appreciate the principles and applications of chromatography and centrifugation Technique

### **19BIOX 315.2 Immunology**

#### **Course Outcomes:**

CO1: Know the cells and organs of the immune system and about antigens and antibodies

CO2: Appreciate complement system and types of immunity.

CO3: Understand vaccination, antibody diversity and transplantation

CO4: Gain knowledge on immunochemical techniques

## **DEPARTMENT OF BIOCHEMISTRY & BIOTECHNOLOGY**

### **M.Sc. Biochemistry (Two-Year) Programme**

#### **19BIOC 101: Biomolecules**

##### **Course Outcomes:**

CO1: Appreciate the hierarchical organisation of various biomolecules.

CO2: Understand the various orders of protein structure, classification, properties and biological importance of proteins.

CO3: Evaluate the structure and hierarchical organisation of nucleic acids with their biological functions.

CO4: Analyse the relationship between the structure and biological role of glycosaminoglycans and glycoconjugates.

CO5: Acquire knowledge on the building blocks of lipids, classification and properties as well as lipoprotein and composition of membranes.

#### **19BIOC 102: Cell Biology and Genetics**

##### **Course Outcomes:**

CO1: Understand the molecular organization of cells and tissues, cell - cell communication, cell junctions, cytoskeleton and extracellular matrix proteins.

CO2: Appreciate membrane composition and transport mechanisms.

CO3: Understand cell division, differentiation, cell cycle and cell death

CO4: Comprehend the steps in cell and tissue culture

CO5: Understand Mendelian principles of genetics, chromosome variation, and population genetics.

#### **19BIOC 103: Enzymes**

##### **Course Outcomes:**

At the end of the course, the student will be able to

CO1: Understand the characteristics, classification, isolation and assay of enzymes.

CO2: Analyse the factors that influence enzyme kinetics.

CO3: Evaluate the mechanisms and regulation by enzyme modulation

CO4: Translate the basic concepts of enzymology to industrial and medical applications

### **19BIOP 104: Core Practical - 1 Practicals in Biomolecules, Cell Biology, Genetics and Enzymes**

#### **Course Outcomes:**

- CO1: Independently undertake qualitative and quantitative analysis of biomolecules
- CO2: Distinguish different cell types
- CO3: Culture cells in vitro and perform cell-based assays
- CO4: Assess various factors influencing enzyme kinetics and undertake enzyme immobilization.
- CO5: Differentiate wild type and mutants of *Drosophila melanogaster*

### **19BIOC 201: Metabolism and Regulation**

#### **Course Outcomes:**

- CO1: Understand the basic principles of bioenergetics and mitochondrial mechanisms in energy production.
- CO2: Appreciate the reaction pathways by which carbohydrates and lipids are synthesised and degraded and know the biochemistry of photosynthesis.
- CO3: Comprehend the metabolic fates of amino acids and the features of protein catabolism
- CO4: Know the biochemistry of porphyrins, purines and pyrimidines and comprehend the integral relationship of metabolic pathways.
- CO5: Know the clinical conditions arising from metabolic dysregulation.

### **19BIOC 202: Immunology**

#### **Course Outcomes:**

- CO1: Describe the components of immune system and the role of cells and organs in immune response.
- CO2: Learn the latest developments in vaccine production and effector mechanisms
- CO3: Understand in depth the abnormal immunologic manifestation in transplantation and hypersensitivity and the genetic mechanisms in antibody diversity.
- CO4: Gain a clear view of immunological mechanisms with a focus on management of diseases cancer, AIDS and autoimmune disorders.
- CO5: Comprehend the principle and application of various techniques ranging from immunodiffusion to ELISA, RIA and flow cytometry.

### **19BIOC 203: Molecular Biology**

#### **Course Outcomes:**

- CO1: Compare the genome structure of prokaryotes and eukaryotes and appreciate the complexity of eukaryotic genome.
- CO2: Discuss the mechanisms of DNA replication, repair and recombination.
- CO3: Explain the enzymes and processes involved in RNA biosynthesis, protein biosynthesis and degradation.
- CO4: Comprehend protein targeting and the role of ubiquitin in protein degradation and chaperones in folding
- CO5 Gain an understanding on the regulation of gene expression at transcriptional, translational and epigenetic levels.

### **19BIOP 204: Core Practical -2 practicals in Immunology and Molecular Biology**

#### **Course Outcomes:**

- CO1: Classify and identify human blood groups and Rh factor.
- CO2; Demonstrate Ag-Ab interaction in vitro by immunoprecipitation and electrophoresis.
- CO3: Analyze quantitatively antigen/antibody reaction by ELISA
- CO4: Extract nucleic acids from biological sources
- CO5: Analyze DNA and RNA by chemical and electrophoretic methods
- CO6: Analyze DNA transfer mechanism in bacteria

### **19BIOC 301: Analytical Techniques**

#### **Course Outcomes:**

CO1: Obtain necessary knowledge to perform techniques essential to biochemistry

CO2: Explain the instrument components, principles of operation and applications of spectroscopy, radioisotope technique and microscopy.

CO3: Exhibit a knowledge base in handling different chromatographic techniques and to make an appropriate choice based on nature of the sample.

CO4: To differentiate the principles of paper, ion exchange, gel and affinity chromatography.

CO5: Apply practically the knowledge acquired on centrifugation for separation of biological samples and isolation of cell organelles.

CO6: Gain knowledge on principles of electrophoresis and learn the procedure for 2D Gel electrophoresis, blotting and hybridisation techniques.

### **19BIOC 302: Molecular Endocrinology and Signalling**

#### **Course Outcomes:**

CO1: Understand the role of hypothalamo-pituitary axis in the coordination of nervous and endocrine system.

CO2: Learn the functions pituitary, thyroid and parathyroid secretions and associated disorders

CO3: Gain an understanding of the actions of adrenal and gonadal, gastrointestinal tract and pancreatic hormones and disorders associated with their hypo and hyper secretion

CO4: Know the different types of signaling, ligand –receptor interaction, cellular messengers of hormones and response pathways triggered by hormonal stimuli

### **19BIOC 303: Physiology and Nutrition**

#### **Course Outcomes:**

CO1: Understand the fundamental components and functions of nervous, digestive, urinary and muscular system.

CO2: State the normal and abnormal composition, functions and clinical significance of investigating body fluids.

CO3: Understand the basic concepts of acid-base and water-electrolyte homeostasis and pathophysiological mechanisms of diseases arising due to imbalance.

CO4: Be aware of energy requirements for humans, malnutrition disorders in children and role of vitamins and minerals in maintaining health.

### **19BIOC 304: Basic Biotechnology**

#### **Course Outcomes:**

CO1: Master the skills associated with growth, cultivation and screening of industrial microorganisms.

CO2: Understand the bioprocess techniques for production of industrially important compounds, SCP, biofertilizers and biopesticides and their applications.

CO3: Comprehend the methodology and applications of microbial mining and bioremediation

CO4: Apprehend the role of rDNA technology in constructing vectors and cDNA and genomic libraries.

CO5: Know the advantages and disadvantages of transgenic plants and foods.

CO6: Know the methods of DNA sequencing, protein engineering, SDM, gene knock in, knockout experiments and learn in detail about human genome project.

CO7: Learn the recent technological advances like precise genome editing, directed evolution and synthetic biology.

**19BIOP 305: Core Practical – 3 Practicals in Analytical Techniques, Molecular Endocrinology, Physiology and Biotechnology**

**Course Outcomes:**

CO1: Show expertise in a variety of separation techniques for lipids, DNA and proteins.

CO2: Gain skill in handling PCR machine, SDS-PAGE, TLC, and HPLC.

CO3: Undertake isolation of subcellular organelles.

CO4: Perform hematology studies

CO5: Quantitate the levels of vitamin C and hormones in blood

CO6: Quantitatively analyze water sample and sewage for microbial contamination and growth respectively.

**19BIOC 401: Clinical Biochemistry**

**Course Outcomes:**

CO1: To describe the molecular basis of genetic and acquired disorders.

CO2: Understand the etiology, findings and management of diabetes, atherosclerosis, and Cancer.

CO3: Describe and explain the diseases of the major organs and systems, organ functional tests for diagnosis and management.

CO4: Compherend the principles of recent advancements in diagnosis and therapy.

**19BIOC 402: Genomics, Proteomics and Bioinformatics**

**Course Outcomes:**

CO1: Understand the types and uses of gene mapping, molecular markers for mapping and classical and new generation genome sequencing approaches.

CO2: Comprehend genome projects, post-genome analysis and ELSI

CO3: Apply the modern methods for separation, identification ,quantitation and structural analysis of proteins

CO4: Apply structural bioinformatics tools to predict and elucidate protein structures and map protein- protein interactions.

CO5: Retrieve, align, analyze and interpret sequence and structural data from databases.

CO6: Construct the phylogenetic tree of different sequences and apply database information for molecular modelling.

**19BIOP 403: Core Practical - 4 Practicals in Clinical Biochemistry and Bioinformatics**

**Course Outcomes:**

CO1: Describe the principles associated with the biochemical measurements performed in clinical laboratory

CO2: Quantitatively analyze blood constituents and assay enzymes of diagnostic importance

CO3: Interpret the result patterns in relation to normal level.

CO4: Apply the knowledge in bioinformatics for phylogenetic analysis of sequences, SNP detection and protein sequence analysis

**Department Electives (DE)**

**19BIOE 205.1: Developmental Biology**

**Course Outcomes:**

CO1: Understand the basics of embryo development in vertebrates and invertebrates

CO2: Learn the events in the early embryonic development.

CO3: Understand the development of organs and developmental pattern

CO4: Understand the events taking place during post - embryonic development.

CO5: Understand the medical implications of developmental biology.

### **19BIOE 205.2: Environmental and Medical Biotechnology**

#### **Course Outcomes:**

- CO1: Apprehend the harmful effects of pollution and biotechnological measures for pollution control.
- CO2: Apply biotechnological process in waste management, cleanup of environment and agricultural improvement
- CO3: Comprehend the fundamentals of biodegradation, biotransformation and bioremediation and apply biotechnological innovation in conservation.
- CO4: Recognize the importance of renewable energy sources and green technology.
- CO4: Use diagnostic kits for screening diseases and understand recent molecular diagnostic methods
- CO5: Know the various new therapeutic approaches like nanotherapy, gene therapy and stem cell therapy.

### **19BIOE 306.1 Genetic Engineering and Nanobiotechnology**

#### **Course Outcomes:**

- CO1: Understand the basic principles of recombinant technology,
- CO2: Appreciate the mechanisms of cloning,
- CO3; Comprehend the methods of gene transfer
- CO4: Understand the principle and applications of DNA sequencing, DNA fingerprinting and PCR.
- CO5: Understand the concept and applications of nanobiotechnology.

### **19BIOE 306.2 Medical Laboratory Technology**

#### **Course Outcomes:**

- CO1: Perform the basic haematology techniques and undertake biochemical analysis of clinical samples
- CO2: Understand the tests performed in clinical microbiology lab.
- CO3: Undertake histological analysis of samples
- CO4: Comprehend the basic techniques performed in clinical immunology laboratory.
- CO5: Know about quality control, lab accreditation and automation

### **19BIOE 306.3 Drug Design and Drug Action**

#### **Course Outcomes:**

- CO1: Understand the basic concepts of pharmacokinetics
- CO2: Know about mechanism of drug action
- CO3: Gain knowledge concepts on drug designing
- CO4: Understand the technologies used in drug development
- CO5 Understand the strategies for new drug discovery and regulatory bodies concerned with drug approval.

#### **Interdepartmental Electives Offered to Other Departments**

### **19BIOX 215.1 Basic Biochemistry**

#### **Course Outcomes:**

- CO1: Understand the structure, classification and properties of carbohydrates and aminoacids
- CO2: Gain knowledge on the hierarchical organisation and properties of proteins, structure and properties of lipids and nucleic acids
- CO3: Comprehend the functions and kinetic characteristics of enzymes
- CO4: Understand the major metabolic pathways of biomolecules

### **19BIOX 215.2 Basic Biotechnology**

#### **Course Outcomes:**

- CO1: Know the principles of bioprocess engineering and downstream processing,
- CO2: Understand the methods applied for waste water treatment and uses of enzymes in industries

CO3: Learn the steps involved in cloning and the importance of biofertilizers and biopesticides.

CO4: Know the basics of food biotechnology and applications of enzymes in food industry.

CO5: Learn about the production of transgenic plants and animals.

### **19BIOX 315.1 Biochemical Techniques**

#### **Course Outcomes:**

CO1: Understand the basic principle, instrumentation and applications of spectroscopy and

CO2: Comprehend the principle and application of radioisotope techniques

CO3: Understand the principle, instrumentation and applications of electrophoresis and blotting

CO4: Appreciate the principles and applications of chromatography and centrifugation Technique

### **19BIOX 315.2 Immunology**

#### **Course Outcomes:**

CO1: Know the cells and organs of the immune system and about antigens and antibodies

CO2: Appreciate complement system and types of immunity.

CO3: Understand vaccination, antibody diversity and transplantation

CO4: Gain knowledge on immunochemical techniques