

Master of Science - Biochemistry

Program Outcome

At the culmination of the 2 years of M.Sc program, the students of the course would instill the ability:

- PO 1-** Assume, inquire and analyse, apply logical principles, validate assumptions, solve problems, integrate knowledge and widen perspectives.
- PO 2-** Promote originality of ideas and deliberate on ambiguity.
- PO 3-** Understand and comprehend the principles and protocols in kinetics.
- PO 4-** Accomplish the objectives of the study with proficient skills to master academic integrity.
- PO 5-** Apply the skills and technique developed in application-oriented aspects of Biotechnology, molecular Biology, Biochemical genetics and to engineer the concepts in a chosen scientific discipline to develop Research inclination.
- PO 6-** Harness cognitive ability, elicit and appreciate biochemical hypothesis, dispel the scientific myths, promote interdependence and help reach conclusions in a research setup.
- PO 7-** Demonstrate the knowledge acquired in topics of social concern like environmental toxicology, nutrition and develop the ability to act with an informed awareness of issues and participate in civic life programs.
- PO 8-** Understand the issues of environmental perspective and remediate it towards sustainable development.
- PO 9-** Acquire the ability to engage in independent, self-directed and Life-long Learning.
- PO 10-** Ability to apply the acquired knowledge to provide cost efficient solutions in the related fields for the benefit of the society.
- PO 11-** An ability to properly understand the technical aspects of existing technologies that help in addressing the biological, environmental, medical and other global challenges faced by humankind.

Program Specific Outcomes

- PSO 1-** Understanding of structure and the mechanism of acquire knowledge on metabolism of macromolecules and the regulation and disorders of metabolic pathways.
- PSO 2-** Gain proficiency in laboratory techniques in both biochemistry, molecular biology, immunology and be able to apply the scientific method to the processes of experimentation and Hypothesis testing.
- PSO 3-** Acquire thorough knowledge in biochemical techniques, immunology, physiology and Biotechnology.
- PSO 4-** Learn to work as a team as well as independently to retrieve information, carry out Research investigations and result interpretations.
- PSO 5-** Develop the ability to understand and practice the ethics surrounding scientific Research.
- PSO 6-** Realize the impact of science in society and plan to pursue research.
- PSO 7-** Understand the issues of environmental contexts and sustainable development.

Course Outcomes

I SEMESTER

BCT-101

- CO1- Understanding the fundamentals of physical processes associated with Surface tension, Adsorption, Viscosity, Distribution law, Osmotic pressure and their importance in living organisms.
- CO2- Understand the laws of thermodynamics, know the importance of high energy compounds and gain knowledge of oxidation – reduction reactions in biological systems.
- CO3- They understand the physicochemical properties and importance of water in biological system, Gain knowledge of buffer preparation and importance of pH and buffers in biological system.
- CO4- Acquaint the concept of stereochemistry in determining conformations of biomolecules and understand the importance of chirality in biological systems.
- CO5- Acquaint with the concepts of chemical bond formation, atomic and molecular orbital, types of bonds and importance of Inductive effect, Resonance effect and Hyperconjugation in stabilization of molecules.
- CO6- Acquire the knowledge of kinetic and non-kinetic methods for investigating reaction mechanism, reactivity of ionic intermediates and free radicals in organic reactions, energy profiles of reactions and characteristic aspects of elimination, substitution and addition reactions.
- CO7- Students gain information about the significance of rearrangement in synthesis of organic compounds of biological importance.
- CO8- Understand the occurrence and role of heterocyclic compounds in biological system.

BCT-102

- CO1- In depth knowledge in structure and functions of carbohydrates will be attained. They will be able to distinguish various biomolecules in membrane receptors, distinguishing blood groups, nature of bacterial membranes etc.
- CO2- Unique skills on characterising the diverse structures of lipids, Comparing the triacylglycerides (triglycerides) and phospholipids. They will have knowledge on use of phospholipids in constructing the biological membranes.
- CO3- They will understand the structure and functions of proteins and impact of structural change on its function.
- CO4- Analyze how steric limitations determine secondary *structure* in polypeptides. the relationship between *protein structure* and function (diseases).
- CO5- In this outcome, learn about the components of DNA and RNA, structural components and get a brief introduction of their sequencing, which helps the students in understanding the techniques of isolation, analysis of nucleotides

BCT-103

- CO1-** The students after the completion of the unit will be able to
- CO2-** Understand the importance of Quality control and assurance in clinical biochemistry laboratory
- CO3-** Understand composition of clinical samples, processing and their storage
- CO4-** Learn about the normal constituents of urine, blood and their significance in maintaining good health
- CO5-** Basic professional skills pertaining to biochemical analysis, carrying out clinical diagnostic tests
- CO6-** The students after the completion of the unit will be able to Summarize the components of blood, blood types, Hemostasis, blood clotting and types of blood test to diagnose the wellness of blood.
- CO7-** Students will learn the enzymes which are used as markers to analyses the parameters of organ health. Clinical significance of diagnostic enzymes is elucidated.
- CO8-** Importance of hormones in health is described. Students will understand the role of hormones in health and disease.

- CO9-** Different tests to check the kidney functions are studied. At the end of the study, students will be able to assess renal function by analyzing various biochemical parameters associated with the health of the kidney.
- CO10-** Formation and excretion of bilirubin is elucidated in this chapter. Students will gain a deeper understanding of different tests which constitute the Liver Function Test panel. Biochemical indices indicating the liver health are elucidated.
- CO11-** The student will be able to understand different aspects of health and disease related to stomach.
- CO12-** They gain knowledge about different biochemical parameters to check the gastric functions.
- CO13-** The student will be able to understand the symptoms, pathophysiology, Causes and diagnosis of the Hemodynamic disorders mentioned above.
- CO14-** After completing this unit student will be able to describe the theoretical background, principle and clinical applications of medical instruments mentioned above

BCT-104

- CO1-** Organization of the body in tissue level is understood biochemical aspects of tissues such as composition of tissues, extracellular matrix is introduced.
- CO2-** Students understand the detailed information about the fibers which constitute the cytoskeleton. Intricate details about the cytoskeletal elements helps the students gain a deeper knowledge of the cell interior.
- CO3-** Study of nervous system provides information about the control and coordination seen in an organism. Study of this chapter ensures students about the importance of neurotransmitters in the proper functioning of body. Studying of nervous system paves path in analysing the different techniques for cognitive neuroscientists.

- CO4-** Muscle physiology is an important concept which gives idea of the structure and function of muscle, physico- chemical aspect helps students to understand the correlation of various organ in the body during contraction. This helps students to understand the role of brain in the function of any organ system. Study of neuro muscular junction creates analytical ideas in students about the spontaneous work done by brain and the co-ordination. This chapter provides in depth knowledge to students and guides them during higher education in many fields like- Physiotherapy, Neurology, Psychology etc.
- CO5-** In this unit students will study in detailed about anatomy and physiology of digestive system this makes the student easy understanding of structure and function of organ students will learn anatomy along with physiology. Emphasis is given to the macromolecules in food, their digestion and absorption.
- CO6-** In this unit students study about anatomy and physiology of respiratory system and cardiovascular system. This will give knowledge about anatomical structure and physiology of the systems. Details of biochemical importance are given emphasis like: diffusion of gases, blood coagulation etc.
- CO7-** Study of anatomy physiology helps in the better understanding of structure and functions of human body. This unit helps in the understanding of role of kidney in excretion, composition of urine and complications in kidney due to certain disorder. Students can identify the practices which can keep their kidney healthy.
- CO8-** Chemistry of hormones and its action is understood. Gain knowledge about different endocrine glands and their hormones and disorders associated. Molecular details are studied such as peripheral transformation, degradation and excretion.

BCT-105

- CO1-** It gives an understanding about calorie, basal metabolic rate, respiratory quotient, and daily energy expenditure, and how these values are measured or calculated. It gives a correlation of Energy requirements for different physical activities. Specific dynamic action (SDA) of food.
- CO2-** To interpret role of carbon-based nutrients and its metabolism and to apply healthy habits in intake of carbon-based nutrition to overcome. To learn the preventive, curative, and/or palliative strategies for the management of conditions or disease states with a nutritional basis/component. Identify the genetic and lifestyle (nutritional) causes of obesity-related disorders such as type II diabetes, and metabolic syndrome.
- CO3-** Identify the diagnostic criteria for syndromes associated with protein malnutrition and disordered eating. Interpret neonatal genetic and laboratory measures consistent with the diagnosis of inborn errors of metabolism. To learn the analysis of protein quality.
- CO4-** It gives an insight to the nutritional role and the disease manifestation related to the hypo and hyper lipid consumption. Its gives a correlation between lipid metabolism and energy contribution.
- CO5-** To identify the syndromes associated with mineral malnutrition and disordered intake and interpret the biological significance of macro, macro and ultra-micro minerals. To identify the syndromes associated with mineral malnutrition and disordered intake and interpret the biological significance of fat soluble and water-soluble vitamins.
- CO6-** It enables the students to know about the scope, types, health impact and future prospectus of food fortification and food additives.

- CO7-** It enables the students to know about the scope, types, health impact and future prospectus of nutraceuticals and functional foods.
- CO8-** To learn about importance of special nutritional requirements according to different age groups and associated nutritional problems
- CO9-** To learn about biological significance of Free radicals, generation of free radical in biological Systems. It gives an important nutritional impact of naturally existing anti-oxidants and to understand the human defense mechanism to combat. To gives overview of the role of free radicals, antioxidant enzymes and antioxidants in health and disease management.
- CO10-** It gives awareness to the students about the toxicants and their impact on the health. To learn the analytical techniques to study pharmacokinetics and pharmacodynamics of toxicants (AMD, Dose response relationship–IC50, LD50, ED50, NOEL). It gives a detailed understanding of the role and mechanism of detoxification enzymes in the elimination of toxic substances. To get deeper understanding of the principle of behind the analysis of toxicant including genotoxicity-Ames test, cytotoxicity assay and diagnosis of toxic effects in liver and kidney. It gives insight on health hazard and risk assessment and management of metal toxicity–Arsenic and lead.

II SEMESTER

BCT-201

- CO1-** Understand the enzyme classification, assay methods and enzyme purification criteria.
- CO2-** Gain knowledge of methods used for identification of binding sites and catalytic sites.
- CO3-** Understand the types of catalysis exhibited by the enzyme, mechanism of action of monomeric and oligomeric enzyme and role of abzymes.
- CO4-** Acquire knowledge about the mechanistic role of the coenzymes in enzyme catalyzed reactions.
- CO5-** Acquaint with the methods used in the investigation of the kinetics of enzyme-catalyzed reactions, understand the kinetics of single and multiple substrate reactions Kinetic data evaluation, factors affecting enzymatic reactions
- CO6-** Understands the types of inhibition and the effect of inhibitors on the kinetics of the enzyme catalyzed reaction and importance of inhibitors in elucidating the metabolic pathways.
- CO7-** Understand the order of mechanism, distinction between different kinetic pathways using primary and secondary plots, characterization of bisubstrate reaction and isotopic investigations of reaction mechanisms.
- CO8-** Acquire knowledge about the cooperative binding, significance of sigmoidal behavior and allosteric regulation.

BCT-202

- CO1-** The students will acquire knowledge of biochemical principles, types of model organisms and choice of model organisms. The unit also demonstrate an understanding of the principles, and have practical experience of, a wide range of biochemical techniques (e.g. basic molecular biology, cell biology and animal and plant culture methods, the use of

standards for quantification, enzyme kinetics; macromolecular purification, micro molecule extractions. The students should be able describe and do calculations with theoretical models for liquid-liquid extraction.

- CO2-** The students will acquire the knowledge about principle behind development of different types of microscopes. It enables the students to employ appropriate microscope for the investigation for specific investigation.
- CO3-** The students shall be able to determine the factors and forces developed in a centrifugal separation. They understand principles of centrifuge to separate materials from one another, types of centrifugations, principles of ultrafiltration and clinical applications of ultrafiltration. Basics of Flowcytometry and its applications in biological and medical research
- CO4-** To learn the basis of the thermodynamic parameters involved in biochemical process such as protein folding, protein denaturation process and protein-protein assembly. It gives an insight to investigate the charges associated with biochemical process employing Isothermic titration and micro calorimeter.
- CO5-** The unit will expose students to methods and instruments used for the measurement of pressure
- CO6-** The student can be able to apply the principles of radiochemistry to quantitative analysis of biomolecules and biological/cellular processes using radiotracer technique.
- CO7-** It enables the students to adopt various statistical formulas/tools to analyse experimental raw data to get overall conclusion/outcome of the experiment. It enables the students to analyse the experimental errors, nature of experimental error random and systemic errors and Identification of systemic errors that could be existing during designing of experiment.

BCT-203

- CO1-** It gives a basic knowledge about the immune system, which is very much essential to understand immunology related advancement in various field.
- CO2-** It gives a basic knowledge about antigens and importance of immune tolerance strategy of immune cells towards self-antigens.
- CO3-** To learn the principles behind the method used to develop Polyclonal and monoclonal antibodies and its importance in application in research and diagnosis
- CO4-** To learn the principle and components of humoral immune response.
- CO5-** It gives an insight of immune system and roles of various immune cells and components. It provides good information related to the role of Cytokines, monokines and lymphokines on the modulation of immune function. It provides the deeper understanding of physiology of acquired immune response.
- CO6-** It gives an over view of interaction between the immune cells during immune response, genetic diversity of antibodies and TCR mediated signaling.
- CO7-** It gives a better understanding of the principle behind the development of techniques based on the antigen–antigen interactions such as Immunoprecipitation, Immunoagglutination and ELISA, it enables the students to understand the basis of Complement fixation assay, Cell and tissue staining techniques, Immuno capture polymerase chain reaction (PCR), ChIP assay, Immuno affinity chromatography (IAC) and Antibody-based biosensors.

- CO8-** It enriches the knowledge about immunological basis of different hypersensitivity diseases. It enriches the knowledge about immunological basis of various autoimmune disorders.
- CO9-** It enables the student to understand the impact of organ/tissue transplant and Transplantation rejection mechanism, which will intern has major impact on organ failure in certain individual
- CO10-** It gives a better understanding of immunological basis of tumor and impact of immunotherapy on tumor irradiation.
- CO11-** It creates awareness among the student fraternity about the importance of vaccines and its impact on gaining resistance against the various infectious and epidemic diseases. It enables the students to understand the methods of development types of different vaccines such as conventional, peptide vaccines, subunit and DNA vaccines.

BCT-204

- CO1-** Comparing and learning the pathways converting complex compounds to simpler compounds and their utilization.
- CO2-** It gives better learning of the pathways converting complex compounds like glycogen to simpler compounds and their utilization. Knowledge of disorders associated with it. of biochemical causes of hypoglycemia, or lactic acidosis.
- CO3-** To know insights of metabolic energy as ATP, and stages of extraction of energy.
- CO4-** In depth understanding of biological oxidation, electron carriers and knowledge of conversion of fuel molecules to energy.
- CO5-** To create awareness on mechanism of ATP synthesis, ATP synthase and its regulation. Biochemical basis for generation of heat.
- CO6-** Understanding the basic pathways of conversion of lipids to energy and correlation of lipid levels to clinical symptoms.
- CO7-** Gives knowledge on conversion of simpler molecules to food molecules by plants and understanding the basic pathways of plants adaptation.

BCT-205

- CO1-** This gives the detailed insight to microbial taxonomy, definition, phonetic and phylogenetic classification methods and Binomial nomenclature of microorganism. They study the basis of modern molecular methods employed in taxonomy including nucleic acid base composition, DNA homology, DNA RNA homology, rRNA sequencing, DNA fingerprinting, Flowcytometry, Chemotaxonomy: cellwall components, lipid composition, isoprenoid-quinones, cytochrome composition, fatty acid profiles; Numerical taxonomy. They also get a better understanding of classification of bacteria according to Bergey's Manual of systematic Bacteriology, Dichotomous keys, Cladograms, dendrograms, universal phylogenetic tree.
- CO2-** They get the overview of protozoans, algae and fungi and their economic importance and cultivation of protozoans, algae and fungi.
- CO3-** They get the overview of cell morphology and different components of cell such as flagella, pili, capsule, cell wall, cell membrane, cytoplasm. Inclusion bodies, nucleoid, plasmids, reserve food materials. They study the General features of different bacterial forms such as coliform, spore formers, lactic acid bacteria, actinomycetes, rickettsiae, spirochetes,

cyanobacteria and Archaea. To learn the principle behind the various staining methods used to study the morphological features of microbes including Gram, Acid fast & flagellar staining.

- CO4-** It helps the students to understand the structure and properties of viruses, Prions and viroids are also described in the chapter. Diseases caused by them are also studied for better awareness of students.
- CO5-** Study of microbial nutrition plays a pivotal role in the microbiological study. Culturing the microbes is better understood with a deeper knowledge of microbial nutrition.
- CO6-** By understanding the enumeration techniques, students will be able to perform various counting techniques to know the growth of microbes.
- CO7-** Various aspects of application of microbes for the production of economically important products including pharmaceuticals will be studied here in this chapter. Study of industrial application of microbes enables the students to know important aspects which are relevant to current industry relevance.

III SEMESTER

BCT-301

- CO1-** Understand the relationship between genes and proteins, experimental evidence of DNA and RNA discovery, relationship between genome size and genetic capacity and analytical methods used to study the shape and size of genome.
- CO2-** Acquaint with modes of replication, topological problems that occur during replication and role of enzymes in overcoming the same. Understand the role of DNA polymerases, mechanism of replication of E.coli DNA, processivity and fidelity of replication and Bacterial replication and its connection to cell cycle.
- CO3-** Gain knowledge of eukaryotic DNA replication, regulation and its difference from that of prokaryotic DNA replication. Understand the replication of organelle genomes and role of inhibitors in inhibiting DNA replication.
- CO4-** They understand the molecular components of prokaryotic, eukaryotic and organelle ribosomes, Translation process and machinery and post translational modifications of proteins.

BCT-302

- CO1-** It provides a deeper understanding of the principle and appropriate use of different chromatographic separation techniques including TLC, Gel filtration, affinity chromatography, ion-exchange chromatography for the separation of various biomolecules.
- CO2-** It enables the students to have greater insight on principle of separation and quantification of macromolecules/organic pollutants/drugs using gaseous mobile phase and liquid stationary phase. It also provides the information about the use of different detectors to specifically detect the analyte in the sample. To enables the students to know the impact of this analytical instrument in R&D labs of various industries including pharmaceutical, agrobased and pollutant analysis-based industries.

- CO3-** It enables the students to have greater insight on principle of separation and quantification of macromolecules/organic pollutants/drugs using HPLC. It provides the information about the use of different detectors to specifically detect the analyte in the sample. To enables the students to know the impact of this analytical instrument in R&D labs of various industries including pharmaceutical, agrobased and pollutant analysis-based industries.
- CO4-** This unit introduces students to the process of protein electrophoresis using Native PAGE SDS-PAGE, IEF, zymography and to the process of DNA electrophoresis and immunoblotting techniques using agarose gels. Students must develop a working understanding of setting up gels and using them to carry out advanced experiments. Additionally, they must be able to carry out blotting procedures including western blots and southern blots. predict from theoretic models how changes in experimental conditions will influence on separations with the methods above describe the construction and function of components in the instrumentation that is used for the methods above
- CO5-** On completion of the unit, the student should be able to:
- CO5.1-** have achieved advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy, to understand and to apply formalisms based on molecular symmetry to predict spectroscopic properties, be able to analyse and interpret spectroscopic data collected by the methods discussed in the unit. Students will be able to solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.
- CO5.2-** Explain the origin of UV-visible absorptions in terms of electronic transitions between stable and unstable molecular orbitals.
- CO5.3-** Explain the origin of infrared absorptions in terms of vibrational modes of covalent bonds.
- CO5.4-** Locate the general region of the infrared in either microns or wave numbers where various types of structural groups exhibit stretching and bending modes, and tell the specific wavelength or frequency where key groups absorb in the I.R.
- CO5.5-** Account for the nuclear magnetic resonance "event" in terms of the precessional frequency of the nucleus as it relates to magnetic field strength and radio oscillator frequency.
- CO5.6-** Predict direction of chemical shifts caused by various structural shielding or deshielding effects.
- CO5.7-** Deduce complete structure of molecules which have fairly simple NMR spectra from interpretation of chemical shifts, peak areas and spin-spin coupling patterns, given the molecular formula.
- CO5.8-** Be able to understand basics of proteomics and metabolomics and principle and functioning of mass spectrophotometer.
- CO6-** On completion of the unit, the student should be able to:
- CO6.1-** Describe how a mass spectrometer works. Types of Inlets, ionization modes, Protein sequence and spectral databases/ libraries
- CO6.2-** Describe protein sample preparation.
- CO6.3-** Describe how to find molecular weight, and base peak from a mass spectrum.
- CO6.4-** Describe simple fragmentation patterns and rearrangements in simple molecules. ion patterns and rearrangements in simple molecules.
- CO6.5-** Describe the difference between DDA and DIA
- CO7-** On completion of the unit, the student should be able to:

- CO7.1-** Describe how a mass spectrometer can be used in metabolomics and lipidomics and workflows
- CO7.2-** Describe metabolite sample preparation with a focus on derivatization.
- CO7.3-** Summarize the data repositories of small molecules and targeted assays
- CO7.4-** Differentiate between Targeted Untargeted metabolomics

BCT-303

- CO1-** Understanding and integrating the knowledge on nitrogen cycle and enzymes involved in it.
- CO2-** It explain the role of transamination reactions in amino acid synthesis and identify the vitamin essential for this reaction (urea cycle).
- CO3-** They gain the Knowledge of degradation of amino acids to energy precursors. Competency in distinguishing the disease states associated with Inborn Errors of Metabolism,
- CO4-** Integrate amino acid synthesis with specific precursors from glycolysis, citric acid cycle and the pentose phosphate pathway.
- CO5-** Integrating the terminology and defining structural features that distinguish different classes of nucleotide metabolites and associated disorders, factors affecting nitrogen balance in health and disease.
- CO6-** Understanding porphyrin and heme synthesis, including normal regulation, lead inhibition, and the clinical manifestations of specific porphyrias.

BTS-307

- CO1-** Understand some basic concepts of research and blooms taxonomy of learning levels.
- CO2-** Identify appropriate research topics, select and define appropriate research problem and parameters, apply statistical tools in design, research and development, Understand, implement and interpreted the general and specific research patterns.
- CO3-** Prepare a project proposal (to undertake a project), organize and conduct research (advanced project) in a more appropriate manner, write a research report and thesis, write a research proposal (grants)
- CO4-** Find the topics from current research in statistics education.

IV SEMESTER

BCT-401

- CO1-** To understand in detail the gene expression in Prokaryotes. The learning process also facilitated by understanding *in vitro* or *in vivo* experiments supporting the concept. A detailed account on lac operon regulation will be dealt with special mention on riboswitches and regulatory cascade controlling lambda phage have been included to maintain continuity in gene regulation.

- CO2-** To obtain a deep insight on gene expression in Eukaryotes with illustrations. The learning process also facilitated by understanding *in vitro* or *in vivo* experiments supporting the concept.
- CO3-** To understand chromatin remodeling in Eukaryotes. The learning process also facilitated by understanding *in vitro* or *in vivo* experiments supporting the concept. Significance of heterochromatin silencing concept laid down with mention on prominent illustrations.
- CO4-** To understand Transcriptional activators role and mechanism in Eukaryotes, to familiarize with Insulators, Co-activators and Mediators role and mechanism.
- CO5-** To understand regulation of gene expression via stability of mRNA in Eukaryotes. Significance of RNAi, PTGS concept will be discussed with mechanism and applications.
- CO6-** To understand molecular biology of Drosophila development by analyzing various *in vitro* and *in vivo* experiments.
- CO7-** They gain the basis of modern techniques used to analyse expression gene such as Northern blots, Primer extension, G-less cassette transcription, measuring in-vivo transcription rate-nuclear run-on transcription, Microarrays, Tilling microarrays, SAGE, and CAGE, Types of RNA sequencing, Differential gene expression and Massively Parallel Signature Sequencing (MPSS) and its applications.

BCT-402

- CO1-** The chapter helps in highlighting the scope and significance of genetics by imbibing the principles of hereditary genetic transmission and interactions of gene with environment. It also helps students to learn the molecular aspects of genetic disorders and mutations. It helps the students to appreciate the concepts of gene and relationship between genotype and phenotype.
- CO2-** Students will be taught Mendelian genetics, their principles and gene interaction. They learn about chromosomal aberrations and structure of chromosomes. The student will gain a basic understanding on human genetics and hereditary.
- CO3-** The chapter teaches the students about genes at molecular level. It also helps students to learn the molecular aspects of genetic disorders and mutations. It helps the students to appreciate the concepts of gene and relationship between genotype and phenotype.
- CO4-** The chapter teaches the students about genes at molecular level in humans. It also helps students to learn the molecular aspects of transposons in relation with genetic disorders and mutations in humans. It helps the students to appreciate the concepts of gene and relationship between genotype and phenotype.
- CO5-** Students will be taught cell division, genetic materials, their structure and types of genetic material in bacteria. Students gain knowledge in mechanism of recombination. Will understand how to develop a linkage map of bacteria
- CO6-** Students will be taught life cycles of phages as well as its structure. They gain knowledge in mechanism of replication in RNA virus. They will understand mechanism of reverse transcription.

BCT-403

- CO1-** After completion of this unit, students should be able to understand the steps involved in cloning.

- CO2-** After completion of this unit, students should be able to describe the properties of restriction and modifying enzymes. They understand the use of restriction and modification enzymes in cloning.
- CO3-** After completion of this unit, students should be able to describe the features of different cloning and expression vectors. They understand the methodology of cloning and screening employed with different vectors.
- CO4-** After completion of this unit, students should be able to describe the methodology for construction and screening of DNA libraries.
- CO5-** After completion of this unit, students should be able to understand the principle and methodology of PCR. Describe the different modifications of PCR and their applications.
- CO6-** After completion of this unit, students should be able to understand the principle and methodology of sequencing. Comprehend the principle of sequence analysis
- CO7-** After completion of this unit, students should be able to understand the use of different transfection methods. Comprehend the use of viral vectors for transformation.
- CO8-** After completion of this unit, students should be able to understand the use of plant tissue culture techniques. Comprehend the use of viral vectors for transformation and expression. They understand the use of different methods for transformation.
- CO9-** After completion of this unit, students should be able to understand the principle of fermentation design, describe different culture systems
- CO10-** After completion of this unit, students should be able to describe the different methods used for downstream processing.
- CO11-** After completion of this unit, students should be able to understand the preparation and application of nanobioparticles, understand the construction and application of biosensors.

BCT-404

- CO1-** It gives an over view of signal transduction pathways, major types of signaling transduction mechanisms including extracellular signaling, Cell surface receptors, major class of cell surface receptors and Intracellular signaling. They learn about the physiological process involved neurotransmission and the role of neurotransmitter, to enable the students to manage the different stress management.
- CO2-** To give a deeper insight on G-protein coupled receptor system (GPCRs) and signaling transcriptional mechanism and its regulation. It enriches the reasoning capacity of students how GPCRs can be a novel drug target to answer certain disease.
- CO3-** This enables the students to understand the role of signaling proteins such as Ser/Thr-Specific Protein Kinases and Protein Phosphatases, to give a deeper insight on signal transduction of different physiological process such as vision. The students get a deeper insight on the role of hormones in coordinating the body physiological activities. They also learn about the different hormonal signaling path ways, it helps them to manage different emotional status by them self.
- CO4-** They learn about the physiological process involved neurotransmission and the role of neurotransmitter. It enables the students to manage the different stress management.
- CO5-** Understand and utilize the scientific vocabulary used in communicating information in Cell cycle and cancer. Describe prokaryotic binary fission, the eukaryotic cell cycle, mitosis and meiosis. Compare and contrast the events of cell cycle and its regulation. Summarize the definition, sources and applications of stem cells. Explain the communications of cells

with other cells and to the environment. They understand cell signaling and how it regulates cellular functions. Also how its dis regulation leads to cancer and other diseases.

PRACTICALS

I SEMESTER

BCP-106

CO106.1 Develop skill and proficiency in preparation of laboratory reagents and buffers.

CO106.2 Use of handling of glass wares, minor equipment for conducting experiments.

CO106.3 Develop skills to prepare standard chemical solutions and secondary standards.

CO106.4 It enriches the practical skill of students in preparing various buffers and the analysis of lipids (saponification number and acid value of oils and fats)

CO106.5 They learn the basic principle behind spectrophotometer by verifying beer lamberts law. Determining the absorption spectra and analyzing the molar extinction coefficient of proteins and nucleic acids.

CO106.6 They acquire a practical skill in spectrophotometric basic for quantification of the following:

CO106.6.1 Total sugars

CO106.6.2 Reducing sugars

CO106.6.3 Total lipids

CO106.6.4 Protein

CO106.6.5 Inorganic phosphate

CO106.6.6 Iron

CO106.6.7 Amino acids (Lysine, Tryptophan)

CO106.6.8 Nucleic acids (DNA and RNA)

BCP-107

CO107.1 Learn separation of serum, plasma, collection of blood samples.

CO107.2 Creating awareness of lab tests that would contribute to the diagnosis of diseases.

CO107.3 Applying and integrating the molecular and metabolic knowledge of conditions and disease states for clinical problem solving (e.g., diabetes).

CO107.4 Applying molecular and metabolic reasoning for evaluate clinical and translational research. Select, justify, and interpret the results of clinical tests in order to identify likely molecular and metabolic causes of disease states.

CO107.5 Predict the effectiveness of, and possible adverse effects associated with, interventions for conditions or diseases based on knowledge of molecular, genetic and cellular regulatory mechanisms.

CO107.6 Demonstrate knowledge and appropriate use of information literacy for the clinical diagnosis, testing, and understanding of biochemistry-based conditions.

II SEMESTER

BCP-206

CO206.1 They gain technical skill in isolation and culturing of Bacteria/ fungi and different staining technique including Grams staining, endospore staining and fungal staining

CO206.2 They learn animal cell culturing technique (Hela cells) and viability staining by Trypan blue assay.

CO206.3 It enhances their skill in bring about the various immunological assay based on the principle of Ag-Ab interaction and agglutination reaction: Radial immuno-diffusion and ODD, human blood group antigens detection, indirect -latex agglutination.

CO206.4 It gives hands on skill in conduction of Antibody titration-based assay– ELISA; Direct, Indirect, sandwich, micro ELISA, Purification of antibodies and Rocket electrophoresis

CO206.5 They acquire the basic practical skill in certain areas of bioinformatics such as

CO206.5.1 Pair wise alignment: BLAST and FASTA of protein,

CO206.5.2 Multiple alignment and Phylogenetic analysis of protein

CO206.5.3 Homology modeling using swiss PDB and Rasmol-Insulin/Cox 2

CO206.5.4 Docking using Autodoc Pyrex

BCP-207

CO207.1 Students will learn to determine the various factors such as temperature, pH, concentration of substrate, concentration of enzyme and inhibitor that affect the kinetics of the enzymes such as esterase, amylase, alkaline phosphatase and urease.

III SEMESTER

BCP-305

CO305.1 Develop skill and proficiency in Chromatographic separations including paper chromatography, TLC,

BCP-306

CO306.1 They acquaint the skill in isolation, quantification and characterization (Spectrophotometric and agarose gel electrophoresis) of genomic DNA, plasmid DNA, mRNA and RNA from different source such as bacteria (*E. coli*)/ plant/ animal source.

CO306.2 This enables the students to acquire hands on skill in most of frequently employed molecular techniques such as restriction digestion, ligation of DNA, melting temperature determination, RAPD, RT-PCR, Phage titration and Southern blotting.

IV SEMESTER

BCP-405

- CO405.1** acquire the practical skill on isolation and cloning of gene into the vector, followed by the transformation of ligated vector into the competent host cell. They acquaint the knowledge and skill in screening of transformed colony by plasmid isolation and restriction digestion of plasmid DNA. The student gets adequate skill in Northern Hybridization (using non-radioactive probes). The students get adequate skill Cloning, Expression and purification of recombinant proteins.
- CO405.2** The students get adequate skill in extraction and isolation of enzymes (phosphatases / esterases / amylases) from Insect / Microbial / Plant sources, further they are enriched with methods of fractionation by Ammonium sulfate, acetone and pH precipitation.
- CO405.3** They acquaint the hands-on skill in purification of enzyme by ion exchange chromatography/Gel filtration chromatography.
- CO405.4** The students gets exposure to demonstrate the enzyme activity after the enzyme being resolved in the gel using native PAGE.

BCP-406

- CO406.1** The project introduces the students to research culture and also induces the student to build logical thinking /reasoning capacity.
- CO406.2** It ignites young mind to think about a social/environmental/medical/ biological issue to solve by novel thinking and come up with the simple solution in the laboratory level.
- CO406.3** This training program equips them to frame the experiment, to process the raw data obtained through experiments and to interpret the data.
- CO406.4** This training program builds their technical confidence in them so that they can face the interviews in the future endeavor.