Biochemistry.

2.6.1 Programme outcomes, Programme specific outcomes and course outcomes for all programmes offered by the institution are stated and displayed on website and communicated to teachers and students.

Biochemistry is an integrated discipline, which confluences the principles of physics, chemistry and mathematics to biology to have a deeper insight into the biochemical interactions to understand the underlying mechanisms of cellular metabolism, respiration and cell-cell interactions. The science of biochemistry uncovers the mysteries of nutrient- cellular interactions leading to sound physical and mental health, addresses the mechanisms of nutritional disorders like protein calorie malnutrition, causes of adolescent anemia and variety of vitamin and mineral- deficiency diseases. The leading science of systems biology has its roots in biochemistry that encompasses the integration of the data obtained from central dogma of molecular biology that provides a clear snapshot of the patho-physiological condition of a person at any given time that shows clearer picture of exact health conditions of an individual. The temporal biochemical investigations using cutting-edge technologies involving bioinformatics, applied maths and statistics evolve early diagnostic biomarkers, prognostic biomarkers and also shows clear picture of disease progression that allows physician to decide on the course of medicine for treatment leading to a logical step close to personalized medicine. Biochemical, enzyme and cell based assays in coordination with animal model experimentation lead the drug discovery. The four semester M. Sc., Biochemistry CBCS programme consists of fundamental understandings study of the synthesis and interactions of chemicals, biomolecules, biomolecular interactions, bioanalytical techniques, basic and applied aspects of endocrine system influencing metabolite/ drug-gene interactions. The medicinal biochemistry, clinical biochemistry, microbiology and immunology courses provides deeper understanding of microbial pathogenesis changing the clinico-pathophysiology and also resistance to diseases. Finally, the courses on genetic engineering, biotechnology and toxicology pave a way towards research and development in diagnostics, drug discovery, pharma and biopharma manufacturing. The course outcome is providing thorough knowledge about understanding biochemical cross talk and the role of enzymes in metabolism and maintaining hemostasis and health and also in drug and diagnostics discovery and manufacturing.

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COURSE OUTLINE AND SYLLABUS FOR M.Sc BIOCHEMISTRY UNDER CBCS SCHEME

SEMESTER-I

S. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-1.1	Physico-Chemical Aspects of Biology	4	4	3	20	80	100
2	CPT-1.2	Analytical Biochemistry	4	4	3	20	80	100
3	CPT-1.3	Biomolecules	4	4	3	20	80	100
4	SPT-1.4.1	Physiology and Nutrition	4	4	3	20	80	100
	SPT-1.4.2	Microbiology and Toxicology	4	4	3	20	80	100
5	CPP-1.5 (1.1)	Physico-Chemical Aspects of Biology	4	2	4	10	40	50
6	CPP-1.6 (1.2)	Analytical Biochemistry	4	2	4	10	40	50
7	CPP-1.7 (1.3)	Biomolecules	4	2	4	10	40	50
8	SPP-1.8 (1.4.1)	Physiology and Nutrition	4	2	4	10	40	50
	SPP-1.8 (1.4.2)	Microbiology and Toxicology	4	2	4	10	40	50
Total				24				600

SEMESTER-II

S. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-2.1	Enzymology	4	4	3	20	80	100
2	CPT-2.2	Metabolism of Fuel Molecules	4	4	3	20	80	100
3	SPT-2.3.1	Cell Biology and Endocrinology	4	4	3	20	80	100
	SPT-2.3.2	Medical Biochemistry	4	4	3	20	80	100
4	OET-2.4	Biological Macromolecules	4	4	3	20	80	100
5	CPP-2.5 (2.1)	Enzymology	4	2	4	10	40	50
6	CPP-2.6 (2.2)	Metabolism of Fuel Molecules	4	2	4	10	40	50
7	SPP-2.7.1 (2.3.1)	Cell Biology and Endocrinology	4	2	4	10	40	50
8	SPP-2.7.2 (2.3.2)	Medical Biochemistry	4	2	4	10	40	50
	OEP-2.8 (2.4)	Biological Macromolecules	4	2	4	10	40	50
Total				24				600

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SEMESTER-III

S. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-3.1	Metabolism of Nitrogen Compounds	4	4	3	20	80	100
2	CPT-3.2	Immunology	4	4	3	20	80	100
3	SPT-3.3.1	Plant Biochemistry	4	4	3	20	80	100
	SPT-3.3.2	Clinical Biochemistry and Dietetics	4	4	3	20	80	100
4	OET-3.4	Biochemical Toxicology	4	4	3	20	80	100
5	CPP-3.5 (3.1)	Metabolism of Nitrogen Compounds	4	2	4	10	40	50
6	CPP-3.6 (3.2)	Immunology	4	2	4	10	40	50
7	SPP-3.7.1 (3.3.1)	Plant Biochemistry	4	2	4	10	40	50
8	SPP-3.7.2 (3.3.2)	Clinical Biochemistry and Dietetics	4	2	4	10	40	50
	OEP-3.8 (3.4)	Biochemical Toxicology	4	2	4	10	40	50
Total				24				600

SEMESTER-IV

S. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-4.1	Molecular Biology	4	4	3	20	80	100
2	CPT-4.2	Biochemical Genetics and Gene Regulation	4	4	3	20	80	100
3	SPT-4.3.1	Genetic Engineering and Biotechnology	4	4	3	20	80	100
	SPT-4.3.2	Biostatistics, Bioinformatics and Drug Discovery	4	4	3	20	80	100
5	CPP-4.4 (4.1)	Molecular Biology	4	2	4	10	40	50
6	CPP-4.5 (4.2)	Biochemical Genetics and Gene Regulation	4	2	4	10	40	50
7	SPP-4.6.1 (4.3.1)	Genetic Engineering and Biotechnology	4	2	4	10	40	50
8	SPP-4.6.2 (4.3.2)	Biostatistics, Bioinformatics and Drug Discovery	4	2	4	10	40	50
	Project-4.7	Project Work	12	6		20 10	Report-80 Viva-Voice- 40	150
Total				24				600

CPT: Core Paper Theory **CPP**: Core Paper Practical **SPT**: Special Paper Theory

SPP: Special Paper Practical **OET**: Open Elective Theory **OEP**: Open Elective Practical

4 Credits of Theory = 4 hours of teaching/ week

2 Credits of Practical = 4 hours/ week

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Department of Studies & Research in Biochemistry

Course outcome

CPT 1.1 - Physicochemical Aspects of Biology

The course enriches the knowledge of the student about the development of hybrid molecules, study the properties and applications of different chemicals furthermore, it gives a clear understanding on the concept and mechanism of synthesis of novel compounds. The second chapter deals with the important aspects of stereochemistry of organic compounds and the mechanism of isomerism, which is of immense importance in drug discovery. The third unit is of immense significance to the students as it deals with the mechanisms of different types of chemical reactions for the synthesis of fine chemicals like NCEs as drug leads by understanding ionic, concerted, electrophilic E1 E2, nucleophilic substitution SN1, SN2, condensation reactions and ester synthesis.

Fourth unit Occurrence of heterocyclic chemicals in biological systems gives a comparative idea of the properties of synthetic heterocyclic compounds and the heterocyclic compounds present in living organisms. Confluence of the knowledge synthetic heterocyclic chemicals to biomolecules would provide excellent drug leads with wonderful activities. Combined with chemometrics and bioinformatics the concept is thought provoking and increases critical thinking capacity to design different molecules like bio-mimitics, biomaterials and fine chemicals as new drug leads.

Fifth unit deals with the generation of free radicals in chemical and biochemical systems and also enriches the knowledge to sequester free radicals using secondary metabolites, secondary metabolites have been explored as drugs and food supplements as nutraceuticals.

This course helps student's employability in Research and Development in biopharma, pharmaceutical, botanicals, drug discovery platforms, analytical and Ayurvedic pharma industry.

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CPT 1.2 - Analytical Biochemistry

This course is designed to understand the basics and the applied aspects of analytical instruments for their application in gamut of industries like, Food, dairy, textile, leather, Pharma, biopharma, ayurvedic, diagnostics, beverage and juice, Extraction units, food supplements, natural product processing, drug formulation, API design and development and water testing etc.

The course enriches the analytical and critical thinking capability of students in a way that it surprises the students by making them understand nano to femto gram of the chemicals present in blood or any given sample can be detected, which otherwise was not known to them.

The course provides the knowledge of separation of organic, biochemical, drugs, phytochemicals etc by different chromatography techniques. The course also provides deeper insight into the standard and applied techniques of separation and purification of protein, enzyme, biopolymer, biopharmaceuticals, antibodies and monoclonal antibodies using different types of chromatographic, electrophoretic, centrifugation techniques that are currently used in research and worlds best industries.

The course also provides the theoretical analytical platform for the analysis of chemicals, formulations and checking the purity of chemicals and pharmaceuticals etc., using basic to high end instrumentation like UV, IR, fluorescence spectrophotometry, HPLC, GLC, Mass spectrometry and NMR. The knowledge of these high end instrumentation is essential for getting jobs in various industries including food, pharma, biopharma, botanical extraction units, diagnostics, etc., as shown above.

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CPT 1.3 – Biomolecules

The course in biomolecules is designed to provide thorough understanding of the various of the biomolecules present in living organisms like, carbohydrates, amino acids, peptides and proteins, nucleic acids and lipids. The course provides thorough knowledge on the properties, applications and their interactions in producing different biological activities. It deals with the simple polysaccharides like starch and cellulose in plants to complex polysaccharides like glycosaminoglycan that make cartilages, tendons of the bone, uncovering this knowledge with critical thinking capability students would think of generating biomaterials for replacement.

The course deals with amino acids, peptides and proteins give a systematic knowledge on the folding patterns of peptides and proteins that fuel activity in these molecules and participate in metabolism. Understanding and exploring folding and refolding patterns would place the students in biotechnology and biopharma companies.

Student will understand nucleotides and nucleic acids, most importantly nucleic acid sequencing and chemical synthesis of nucleic acid, which is of greater demand in Research & Development of Biopharma and agriculture industries. The Biopharma support industry that supplies tools for genetic engineering provide jobs for probe and primer synthesis.

The course also offers a great deal of understanding about the properties of lipid molecule and lipid mediators in cell signalling etc. The study on the integration of metabolism involving lipid mediaters provide thought exceptionally good understanding of cellular pathways and perturbations by mediator molecules. The study helps students to take up jobs in Biochemical, enzyme and cell assays in different CROs for drug discovery, pharma, biopharma, and agriculture based seed development companies.

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SPT 1.4.1 - Physiology and Nutrition

- Have an enhanced knowledge and appreciation of mammalian physiology
- Understand and distinguish the functions of circulatory, muscular and digestive systems in the body.
- Understand the digestion and absorption of carbohydrate, protein and lipids.
- Understand the functions of vital organs including liver, kidney and lungs in the body.
- Understand the functions and composition of blood.
- Understand the role of individual blood cell and importance blood count and differential count.
- Comprehend the anatomy of the circulatory, muscular and digestive systems in the body.
- Understand the anatomy of vital organs including liver, kidney and lungs.
- Illustrate the processes of the organ systems and vital organs.
- Get sensitized about functions of each system and organs during physiological conditions.
- Elaborate the regulation of body fluids and blood parameters.
- Understand the functions of important physiological systems including the cardio-respiratory, renal, and metabolic systems.
- Understand how these systems interact to yield integrated physiological responses to challenges such as exercise and fasting.
- Understand the basic concepts of nutritional Biochemistry
- Gain knowledge on metabolism of macromolecules including carbohydrates, proteins and lipids.
- Acquire knowledge on functions and mode of action of different micro and macronutrients.
- Relate metabolism of different nutrients with dietary intake.
- Suggest preventive measures to overcome metabolic abnormalities.
- Suggest preventive measures to overcome malnutrition associated problems.
- Gain knowledge on Basal Metabolic Rate and Standard Dynamic Action of foods.
- Understand the Recommended Daily Allowance, the estimated amount of a nutrient (or calories) per day.
- Knowing the nutrition for infants, children, pregnant women and aged peoples.
- Understand the factors affecting the nutritional status.

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CPT 2.1 – Enzymology

In this paper the students are going to study about nature of enzymes, localization, isolation, purification and characterization of enzymes. Criteria of purity of enzymes, fold purity. Nomenclature and IUB classification of enzymes. Enzyme specificity, specific activity, assay methods; coupled enzyme assays, continuous, end point and kinetic assay. Units of enzyme activity, IU and Katal. Industrial and Biomedical applications of enzymes.

Michaelis-Menten equation, initial velocity approach, steady state approach. Vmax, Km and their significance. Linear transformation of Michaelis-Menten equation; Lineweaver-Burk plot, Eadie-Hofstee, Wolf and Cornish-Bowden. Scatchard plot. Rate of a reaction, order and molecularity.

Chymotrypsin; zymogen activation, acid-base catalysis, charge relay network. Lysozyme, alcohol dehydrogenase, ribonuclease, carboxypeptidase A, RNA as an enzyme.

Enzymes are involved in the many biological roles to sustain life. In this course to understand the physical, chemical and kinetic properties of enzymes. Purification, characterization and quantitative evaluation of the influence on the substrate concentrations, pH, temperature and inhibitors on activity. Enzymes are play crucial role in industries like pharmaceutical , food, beverages, enzyme immobilization, protein, detergent, biofuel, microbial industries, cosmetics and paper and pulp. This paper helps students for their research in their respective fields in national research institutions. Identification of particular diseases through enzyme pathways that leads to the invention of drugs.

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CPT 2.2 – Metabolism of fuel molecules

In this paper students will discuss about basic concepts in metabolism: catabolism, anabolism, catabolic, anabolic and amphibolic pathways.

In this unit the students study about carbohydrate metabolism such as glycolytic pathway, energetics and regulation of glycolysis, fate of pyruvate, oxidation of pyruvate. Citric acid cycle and its regulation, energetics, anaplerosis. Gluconeogenesis and its regulation, Cori cycle, glyoxylate cycle. glucose paradox. Futile cycles and their applications. Entry of other carbohydrates into glycolysis-fructose and galactose.

The study also includes effect of insulin and glucogon, catecholamines, growth hormones and carticosteroids on carbohydrate and lipid metabolism in different tissues. Action of thyroid hormones and their mechanisms.

In addition they study about degradation of triacylglycerols, phospholipids and sphingolipids and regulations; lipase, hormone sensitive lipase, phospholipases and sphingomyelinase. Fatty acid degradation; α and β and ω-oxidation. Knoop's experiment, saturated and unsaturated fatty acids. Formation of ketone bodies and their oxidation. Energetics and biosynthesis of fatty acids; fatty acid synthetase complex, chain elongation and desaturation. Pathways in plants and animals, conversion of linoleate to arachiodnante.

Thermodynamics study is also included I, II and III laws of thermodynamics. Enthalpy, entropy, free energy and chemical equilibrium. High energy compounds-Energy currency, ATP, ADP, creatine phosphate, phosphoenol pyruvate as energy rich compound.

Entry of reducing equivalents for oxidation; malate-aspartate shuttle, glycerol phosphate shuttle. Organization of respiratory chain complexes, structure and function of the components; Fe-S proteins, cytochromes, Q cycle, proton transfer, P/O ratio, respiratory control, oxidative phosphorylation, uncouplers and inhibitors, sequence of electron carriers based on redox potentials. ATP synthesis, ATP synthase complex, binding change mechanism, proton motive force, Mitchell's hypothesis.

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SPT 2.3.1 - Cell Biology and Endocrinology

- Understand the differences between prokaryotic and eukaryotic cell organization and cellular components.
- Understand the features and reasons for cell compartmentalization.
- Acquire knowledge on the process of life through cell cycle.
- Understand the structure and functions of the plasma membrane, transport across cell, cell-cell communication and cell-extracellular matrix communications.
- Understand the cell-cell communication and mechanisms of signal transduction.
- Understand the external membranous structure and function of living cell.
- Conceptualize and describe vesicular trafficking of secretory proteins and cell secretions. Gain knowledge about the primary functional organelles of a cell.
- Understand the basis of nerve transmission and neurotransmitters.
- Understand the basis of signal transduction.
- Understand the basic functions and pathways insides cell.
- Understand the cross talk between molecular signalling pathways.
- Students will be able to describe the origin and functions of each hormone.
- Students will be able to describe major actions of each hormone on target cells.
- Students will be able to describe pathways for synthesis and inactivation for peptide hormones, steroid hormones, thyroid hormones, and catecholamines.
- Students will be able to describe the control of synthesis and secretion for each hormone, including feedback relationships.
- Students will be able to describe major signalling pathways in target cells for each hormone.
- Students will be able to describe methodologies used to test hypotheses in study of problems in endocrinology.
- Students will be able to describe and recognize etiology and clinical symptoms of the major endocrine diseases.
- Student will be able to describe the circadian rhythm and endogenous conditional anti-oxidant melatonin.
- Student will be able to describe the plant hormones, insect hormones, and Pheromones
- Student will be able to describe the uses of plant hormones, insect hormones, and Pheromones in agriculture, horticulture and animal husbandry.

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OET 2.4 – Biological Macromolecules

For second semester open elective theory and practical deals with brief introduction, biological importance, biochemical properties of lipids and nucleic acids.

Monosaccharides- Classification, Sugar derivatives. Disaccharides- structure of sucrose, lactose, maltose and cellobiose. Structure, Properties and importance of homo and heteropolysaccharides–starch, glycogen, cellulose, dextran, agarose and alginate. Glycosaminoglycans, glycoproteins, antifreeze glycoproteins, bacterial cell wall polysaccharides and blood group antigens.

Introduction, classification and biological functions. Composition of proteins. The size and conformation of proteins. Supramolecular assemblies of proteins. The functional diversity of proteins.

Brief account of the chemistry and classification of lipids (without structural elucidation). Biological role of the following: Fatty acids, Aryl glycerols, Cholesterol, Terpenes, Waxes and Bile salts, Phospholipids, Sphingolipids, Glycolipids, Steriods, Prostaglandins, Thromboxanes and Leukotrienes. Properties of lipids aggregates- micelles, Bilayer and Liposomes.

Structure and properties of nucleosides and nucleotides. Properties of nucleic acids in solution. Hydrolysis of nucleic acids by acid and base. Enzymatic hydrolysis, Nuclease specificity and restriction endonucleases. Chemistry of DNA- Structures and functions of DNA, staining of DNA, PCR and its applications. Chemistry of RNAs: Structures and functions of mRNA, tRNA and rRNA.

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CPT 3.1 – Metabolism of nitrogen compounds

In this paper students learn about introduction to biological and non-biological nitrogen fixation, brief introduction to nifgenes, utilization of nitrate and nitrites, regulation of nitrate reductase.

Study of degradation pathways of the individual amino acids in animal, plant and microbial systems-Glucogenic and ketogenic amino acids and their significance. Degradation of amino acids forming pyruvate (alanine, glycine, threonine, serine, cysteine, cysteine and tryptophan) oxaloacetate (aspartic acid and asparagine), α- ketoglutarate (glutamic acid, glutamine, arginine, histidine and proline), succinyl CoA (valine, isoleucine, threonine and methionine), Fumarate (phenylalanine, tyrosine) acetoacetate and/or acetyl CoA (leucine and lysine), pyruvate, formaldehyde, acetoacetate and/or acetyl CoA (tryptophan), and fumarate, acetoaetate and/or acetyl CoA (phenylalanine and tyrosine). Inherited disorders associated with glycine, aromatic, branched- chain, basic and sulfur containing amino acid metabolism.

General metabolic reaction of amino acids– transamination, pseudotransamnation, glucose–alanine cycle, oxidative deamination (glutamate dehydrogenase), minor pathways of amino acid degradation – transdeamination, amino acid oxidase, and non – oxidative deamination (α– deaminase, dehydrase, asparaginase and glutaminase). Assimilation of ammonia, formation of amino acid amides by glutamine synthetase and its regulation. Urea cycle– regulation and metabolic disorders. Biosynthesis of creatine and creatine phosphate, polyamines– putrescine, spermidine and spermine, glutathione (γ-glutamyl cycle), physiologically active amines (serotonin. γ-amino butyric acid, histamine, and catecholamines – dopamine, epinephrine and epinephrine).

In this course beneficial to students to know and learn the mechanism of how nitrogen fixation from the atmospheric nitrogen to usable nitrogen. To study the general mechanism involved in the amino acid metabolism and synthesis of physiological amines, catecholamine in the system. The important aspect is to know the degradation and biosynthesis of amino acids, nucleotides heme and inborn errors in the metabolism.

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CPT 3.3 - Immunology

In this paper of Immunology the students learn about types of immunity- innate and adaptive. Immune reactive cells. Humoral and cell mediated immunity. Anatomy of lymphoid organs- primary lymphoid organs, secondary lymphoid organs and lymphtic system. Antigens- chemical nature, types, antigenicity, haptens, epitopes, antigenic determinants, adjuvants and super antigens.

With addition to this they learn the techniques of immunology such as precipitation, agglutination, complement fixation, immuno diffusion, immunoelectrophoresis, immunofluorescence, RIA and ELISA.

Antibody production which is a technique of very immense application in industry and pharmaceutical company. Students learn about basic structure, functions, theories of antibody formation, classes and immunoglobulin super family. Antigenic determinants on immunoglobulins. Methods of raising polyclonal antibodies. Monoclonal antibodies – production and application.

In addition they will also learn about disease conditions such as barriers to infection; skin, mucous membrane, inflammation, hyper sensitivity reactions (Type I, II, III and IV). Tumour associated antigens, factors favouring tumour growth, immune surveillance. Tumour necrosis factor-α and β. Immunological tolerance, auto immune disorders, AIDS, SCID.

They learn about adjuvants, vaccines and their preparations. Polyclonal and monoclonal antibodies; hybridoma technique.

With this they can get into pharmaceutical companies, industries, research institutes and diagnostic centres for their employability.

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ಅಧ್ಯಯನ ಮತ್ತು ಸಂಶೋಧನಾ ವಿಭಾಗ
ತುಮಕೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ತುಮಕೂರು-572103

SPT 3.3.2 - Clinical Biochemistry and Dietetics

- Familiarize with collection of biological samples and preservation.
- Collect and preserve the biological samples.
- Know how to separate the serum and plasma for analysis.
- Analyse the urine and blood for various diseases.
- Appreciate the importance of biochemical tests in clinical practice.
- Learn the clinical significance of enzymes like SGOT, SGPT, LDH, CPK, CK, Alkaline and acid phosphatase, amylase.
- Learn how to assess the renal and liver functions.
- Understand the biochemical basis of various diseases.
- Learn the appropriate tests to assess organ function.
- Know more about various tests associated with different organs and tissues.
- Interpreting biochemical data and correlating with clinical data.
- Correlate biochemical findings with disease onset and progression.
- Apply their clinical knowledge to investigations in human diseases.
- Apply their knowledge gained to understand more about calculi and its components.
- Clinical significance of metabolic disorder of carbohydrate, protein and lipid.
- Relate the causes, symptoms and onset of various types of diseases including Diabetes, CVD, Liver and kidney diseases.
- Understand the food groups and their functions.
- Understand the concept of therapeutic nutrition and diets
- How to categorize the diseases, disorders and deficiencies for planning suitable diets?
- Comprehend the importance and principles of dietetics for infants and children
- Understand the different therapeutic diets
- Understand the basic principles involved in planning diets for different disease conditions.
- Understand the etiology, management and prevention of life style disorders
- Learn about etiology, clinical symptoms, diagnosis, treatment and dietary modifications in gastrointestinal diseases
- Enumerate on the clinical symptoms and dietary modifications of various kidney and liver diseases
- Know the importance and principles of dietetics as a distinct therapy for diseases
- Learn the dietary management for gastrointestinal, liver and gall bladder diseases.
- Know the importance and principles of dietetics in the management of diabetes
- Gain knowledge in planning and preparing diets for CVD, diabetes, and hypertension
- Gain knowledge on causes, nutritional care and treatment of cancer.
- Relate dietary management for nutritional deficiency diseases.

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OET 3.4 - Biochemical Toxicology

Students who take this paper in their M.Sc in Biochemistry will:

- Understand the principles of toxicology and treatment of various poisonings.
- Understand the processes involved in absorption, distribution, metabolism and excretion of toxicants.
- Understand the pharmacokinetics and pharmacodynamics of toxicants in mammals.
- Understand how to investigate the metabolism of toxicants in laboratory mammals.
- Understand the principles and approaches used to of the metabolic activation of chemicals to toxic metabolites.
- Understand the target organ toxicity involving the following organ systems: liver, kidney blood, cardiovascular, immune, skin, gastrointestinal, pulmonary, reproductive, endocrine, and central and peripheral nervous systems.
- Understand about what are the typical mechanisms through which chemical toxicants affect the structure and function of these systems as well as macromolecules.
- Understand mechanisms of systemic and organ toxicity induced by xenobiotics.
- Understand the lipid peroxidation as a mechanism of chemical-induced toxicity and understand of metal induced toxicity.
- Understand the use of genetics and genomics in biochemical toxicology.
- Understand the role of epidemiology and animal studies for the identification of chemical carcinogens in humans.
- Understand the fundamental process of cancer, cell proliferation, chemical-induced DNA damage and DNA repair mechanisms.
- Understand the roles of cell signalling mediated by membrane receptors and of the nuclear effects of signalling cascades in chemical induced toxicity.
- Understand the methods involved in evaluating the toxic effects of chemicals on selected organ systems (e.g., lung, eye, CNS, reproductive, kidney, liver).
- Understand the methods for evaluating the hazards associated with environmental exposure to toxicants.
- Understand how air pollutants, metals, pesticides, insecticides, herbicides induce toxicity towards organs.

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CPT 4.1 – Molecular Biology

The course in molecular biology is designed to offer complete understanding of central dogma of molecular biology. The course in mechanism of DNA replication in prokaryotes and eukaryotes provides a clear understanding the events and the enzymes involved, which is significant in working with DNA in Upstream process and genetic engineering platforms of biopharma industry and vaccine producing industries.

The concept of transcription and translation mechanism in pro- and eukaryotes lead to greater understanding of gene expressions in various environments and organisms. The study supports controlling of expression of genes and translation into protein product in the organisms involved in the industrial production of insulin, growth hormone, t-PA, erythropoietin, interferons, cytokines, monoclonal antibodies and expression of genes in agricultural traits. The knowledge of mechanism of transcription and translation control yield good job perspectives in research and development in academics, biopharma, vaccine, agriculture, food and dairy, wine and juice making industry and various other support and service industries.

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CPT 4.2 - Biochemical genetics and gene regulation

The course is designed to have a basic understanding of the genes and their function for their application in correction of genes, diagnosis, designing vectors for genetic engineering and biotechnology and aid in genomics study for diagnosis predisposed diseases and their correction.

Classical genetics and human genetics provide the basic information of genes and their affects. The course human genetics part provides knowledge about the applied aspects gene sequencing, repository of human genome project, assessment of genes and activation and silencing genes, which helps in understanding eukaryotic gene regulation and expressions, what is exactly needed to work in R & D wing, production and development of biopharma industry using mammalian cell fermentation.

The course in microbial genetics and gene expressions gives a deep understanding of the techniques used in controlling gene expressions. A clear understanding of control of gene expressions and silencing combined with strong understanding of enzymology and cell systems will lead to development of novel vectors and host organisms for genetic engineering.

The course in Biochemical genetics and gene regulation helps student's placement in platforms that are involved in making new vectors, host cells, developing DNA based diagnostics, genomics platform, upstream process development and in traditional biotechnology industry.

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SPT 4.3.1 - Genetic engineering and biotechnology

Genetic engineering and biotechnology is a promising area on which various The first half of the course gives detailed knowledge about the process of isolation of DNA, RNA and isolation and identification of gene using different enzymes and equipments.

Genetic engineering- This chapter provides knowledge on the construction of vectors for use in E coli, Bacillus, yeast, insect cells, plant cells and mammalian cells systems. Creation of genetically engineered organism- *in-vivo* and *in-vitro* gene cloning, gene expressions in bacterial, yeast and mammalian systems. Gene transfer in plants to development of pest resistant and high yielding crops and crops enriched with vitamins like, cotton, maize, golden rice.

The course provides deeper knowledge of development and industrial production of biopharmaceuticals like insulin, growth factor, erythropoietin, t-PA, interleukins, cytokines, diagnostics, different types of vaccines, monoclonal antibodies for cancer therapy and diagnosis.

The course also provides deeper insight into the development, functioning, and working of fermenters and fermentative production of amino acids, commodity organic acids, vitamins, antibiotics, biopharmaceuticals, vaccines, enzymes, vaccines, textile and leather industry etc.

This course helps students placements in Research and development, production, upstream and down-stream process development, Quality control and assurance in variety of industries like pharma, biopharma, diagnostic, enzyme, vitamins, biochemical, detergent, textile, leather tanning, agriculture, horticulture, food and feed processing, dairy, wine and beverage, petrochemical and petroleum processing, environmental, agricultural seed development, biopesticide industry and all other industries that releases effluent.

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