

BIOCHEMISTRY

Learning Objectives

At the end of the course, the learner should be able to

1. Understand, describe and summarize the molecular and functional organization of cells. Structure-function relationship and inter relationships of various biomolecules in health and disease.
2. Summarize the basic and clinical aspects of Enzymology with emphasis on diagnostic enzymes.
3. Understand and describe digestion, assimilation of nutrients and associated disorders like obesity, malnutrition and malabsorption.
4. Understand, describe and integrate the various metabolic pathways and their regulation.
5. Describe mechanisms involved in water electrolyte and Acid Base Balance.
6. Understand and summarize basic molecular mechanism of organization of genome, genetic expression and regulations; recombinant DNA technology and genetic engineering and explain the biochemical basis of common inherited disorders in India
7. Summarize the basic aspects of immunology including body defence mechanism.
8. Understand the biochemical aspects of carcinogenesis and effects of xenobiotics.
9. Identify principles of routine and specialized biochemistry laboratory investigations and techniques ; analysis and interpretation of biochemical laboratory reports.
10. Use basic devices for qualitative and quantitative biochemical investigations.

Course Contents

	Must know	Desirable to know
Cell Biology		
I. Importance and scope of concept of medical biochemistry in prevention, diagnosis and therapeutics of diseases.	✓	
II. Organization of cellular structures and their functional roles,	✓	
III. Cell membranes, mechanism of transport across typical cell membrane	✓	
Acid Base Balance		
Basic concepts: pH, Acids, Bases, Buffers, Henderson Hasselbalch Equation in relation to body systems. Role of kidneys and lungs in Acid base homeostasis.	✓	
Acid base disorders, causes and laboratory diagnosis		✓
Vitamins		
Dietary sources, biochemical role, deficiency manifestations, daily requirement and RDA; Hypervitaminoses and Vitamin antagonists in medicine.	✓	
Enzymology		
Basic concept of catalysis, classification, mechanism of enzyme activity, factors affecting enzyme activity, importance of Km valve. Types of enzyme inhibition and their clinical application.	✓	

	Must know	Desirable to know
Enzyme regulation - modes, mechanisms and importance in the human system.	✓	
Diagnostic and therapeutic importance of enzymes.	✓	
Bioenergetics and Biologic oxidation		
concepts of bioenergetics in relation to thermodynamic principles as applied to the human system., Phosphagens Substrate level phosphorylation	✓	
Organization of Electron transport system, Oxidative Phosphorylation - formation of ATP and its regulation - uncouplers and inhibitors.	✓	
Formation of free radicals, consequences and disposal of free radicals.	✓	
Digestion and absorption from GI tract		
Digestion and Absorption of Carbohydrates, lipids, Proteins	✓	
Malabsorption syndrome		✓
Carbohydrates		
Classification and biologic importance of carbohydrates. Role of hetero polysaccharides (glycoso aminoglycans), role of dietary fibre in health, use of dextrans as plasma expanders.	✓	
Glucose Transporters, Glycolysis, TCA cycle, glycogenesis, glycogenolysis and functional significance of HMP shunt and uronic acid pathway Gluconeogenesis, Galactosemias, Overview of Glycogen storage diseases	✓	
Regulation of Blood Glucose level, Insulin receptor and Insulin Resistance, metabolism in starvation and Diabetes mellitus, Lab diagnosis and monitoring of Diabetes Mellitus; Biochemical basis of acute and chronic complications of Diabetes Mellitus	✓	
Reactions of the HMP shunt pathway,	✓	
Uronic acid pathway, basic concepts of Glycogen storage diseases		✓
Lipids		
Classification, Composition and biological importance of lipids Structure of typical biomembranes	✓	
Fatty acid oxidation, ketosis, major steps in cholesterol biosynthesis and breakdown.	✓	
Overview of fatty acid biosynthesis and phosholipid metabolism Fatty liver and lipotropic factors	✓	
Arachidonic acid derivatives-Prostaglandins and biochemical actions	✓	
Lipoproteins classification and functions and disorders	✓	
Proteins		
Various classifications of Amino acids and Proteins; Important biochemical properties, Structural organization and structure- function relationship of proteins eg Hemoglobin, myoglobin and collagen;	✓	
Denaturation Biochemical basis of Sickle cell anemia and Thalessemia	✓	
Formation and disposal of ammonia- urea cycle	✓	

	Must know	Desirable to know
Overview of metabolism of amino acids: phenylalanine, tryptophan, glycine, serine, Sulfur containing aminoacids, histidine	✓	
Specialized products obtained from amino acid, metabolism and their importance, eg. creatine, melatonin, Melanin, Epinephrine, Thyroxine		✓
Intermediary metabolism		
Concept and methods of study of intermediary metabolism, inter-relationships of metabolites of carbohydrates, Amino Acids and Lipids.	✓	
Regulation by hormones in starvation well fed state and Diabetes Melitus.	✓	
Nucleic acids		
Types, Composition and Nucleic acids, Purine and pyrimidine base pairing rules in nucleic acids	✓	
Sources of atoms of purine and pyrimidine rings	✓	
Overview of biosynthesis	✓	
Disorders of Nucleic acid Metabolism- hyperuricemias,	✓	
Reactions of Biosynthesis of purines and pyrimidine bases. Disorders of pyrimidine metabolism.		✓
Mineral metabolism		
Dietary sources, functional importance, regulation and altered levels of calcium, phosphorus, Iron, Zinc, Copper, Iodine, Fluoride Sodium, Potassium, in the body.	✓	
Selenium, Magnesium, Manganese and Chromium.		✓
Human Genetics and Molecular biology		
Organization of Genome, Phases of cell cycle, DNA, RNA metabolism	✓	
Replication, transcription DNA.	✓	
Modification of RNA,	✓	
Translation of mRNA, post translational modification	✓	
Regulation of Genetic expression, Mutations - Concept and types and DNA Repair mechanisms.	✓	
Principles and applications in Medicine of Recombinant DNA Technology, polymerase chain reaction (PCR) and gene therapy		✓
Splicing of RNA, Prion disease, steps in PCR		✓
Clinical Biochemistry		
1. Hemoglobin Metabolism - Breakdown of Hb, Biochemical basis of jaundice and distinguishing features of different types of jaundice	✓	
2. Porphyrrias - outline of biosynthesis of Heme, overview of causes and types of porphyrias, lab diagnosis	✓	
3. Plasma proteins - Classification, separation techniques, functions and altered levels of plasma protein in diseases.	✓	

	Must know	Desirable to know
4. Hepatobiliary function tests - Common tests performed and interpretation of laboratory reports.	✓	
5. Thyroid function tests - Common tests performed and interpretation of laboratory reports.	✓	
6. Renal function tests - Common tests performed and interpretation of laboratory reports.	✓	
7. Energy metabolism a) computation of energy yield from complete oxidation of glucose. b) Concept of Balanced diet c) Nitrogen balance, d) Calorific value of foods.	✓	
8. Biochemistry of Cancer - Role of carcinogens in carcinogenesis, Tumor, suppressor genes oncogenes Tumor markers - common parameters and their utility in clinical practice	✓	
9. Biochemistry of Atherosclerosis and Diagnosis of Myocardial infarction. Biochemical factors causing Atheroma, Hyper lipidemias. Laboratory Diagnosis of Myocardial infarction.	✓	
Principles of laboratory practice		
General principles of assays of biochemical parameters	✓	
Photometric assays, Beer Lamberts Law, ELISA and RIA Techniques.	✓	
Principles and application of chromatography and electrophoresis.	✓	
Principles and applications of Radioisotopes in Medicine.	✓	
Use of Blood Gas Analysis	✓	
Concept of dry chemistry methods for qualitative and quantitative analysis of biochemical parameters.	✓	

SKILLS

	Able to perform independently	Able perform under guidance	Assist	Observe
1. Use conventional techniques. And basic instruments to perform biochemical analysis in bio-fluids to clinical screening and diagnosis. Use of colorimeter, Centrifuge, Glucometer, etc	✓			
a) Perform complete urine analysis for normal and abnormal constituents present in urine	✓			

	Able to perform independently	Able perform under guidance	Assist	Observe
b) Estimate glucose, urea and creatinine, Bilirubins, Amylase, Alkaline Phosphatase, Cholesterol in blood		✓		
c) Use Dry chemistry methods (Stick / Spot methods) for detection and assay		✓		
d) Perform chemical reactions to demonstrate important properties of Carbohydrates, Proteins, Lipids etc .	✓			
2. Analyse and interpret investigative data	✓			
a) Individual and Composite reports				
b) Functional tests / organ profiles Cardiac, Thyroid, Renal, Hepatobiliary tests Bone parameters, Lipid profile, Diabetic profile etc				
c) Chromatograms, Electropherograms				
3. Collect Blood for Biochemistry parameters Transport, Storage of biofluids for biochemical analysis Check for preanalytical errors				✓ ✓
4. Universal precautions to be taken during laboratory procedures	✓			
5. Interpretation of Blood Gas Analysis, Electrolyte analysis(ISE),		✓		
6. Apply concepts of Rational Diagnostic Methods and tests in laboratory medicine.	✓			

B. TEACHING LEARNING METHODS

Structured Interactive sessions, Tutorials, Group Discussions, Seminars, Projects, Self learning modules and e-modules etc.

PRACTICAL SKILLS

Demonstration, Practical exercises and OSPE, Group exercises for Interpretive skills.

Suggested topics for e- Learning modules

- Mechanism of action of enzymes
- Oxygen and CO_2 (Transport of gases by Hemoglobin)
- Genetic Mechanisms
- Organisation of the Genome

- ii) Replication
- iii) Transcription
- iv) Translation
- v) Mutations and repair - Inherited diseases of metabolism
- vi) Recombinant DNA technology
- d) Lipoproteins in Atherosclerosis
- e) Automation in a Clinical Biochemistry laboratory
- f) Principles of Immuno Diagnostic Tests and their interpretation .

SUGGESTED BOOKS IN BIOCHEMISTRY:

1. Harper's review of Biochemistry
2. Textbook of Biochemistry by D M Vasudevan and Srikumari
3. Medical Biochemistry by Dinesh Puri