

Clinical Biochemistry

Course Code	Title of Course	Credit Hours
MTD-353	Clinical Biochemistry	3(2-1)

Learning outcomes:

Students will be able to:

- Explain the structure, classification, and functions of biomolecules including proteins, carbohydrates, lipids, nucleotides, vitamins, and minerals, and relate them to human health and disease.
- Describe key metabolic pathways and enzyme mechanisms, and analyze their roles in normal physiology as well as in metabolic disorders such as diabetes, hyperlipidemia, and inborn errors of metabolism.
- Understand the structure and function of nucleic acids, the genetic code, and protein synthesis, and relate these to biochemical and clinical applications.
- Apply knowledge of micronutrients and biochemical principles in nutritional assessment, laboratory diagnosis, and disease prevention through supplementation.

Course Contents:

Theory:

Introduction to biochemistry: definition, scope, and significance, the molecules and chemical reactions of life; Amino acids and proteins, amino acid chemistry, classification, and protein chemistry, structure, and classification; Carbohydrates: classification, monosaccharides, disaccharides, polysaccharides, and special biological roles; Lipids and membranes: structure, classification, biological functions, and the role of membranes in cellular function and metabolism; Nucleotides and nucleic acids: nucleotide chemistry, nomenclature, structure of purines and pyrimidines, important function of nucleotides, and abnormalities of purine metabolism such as gout and hyperuricemia; Enzyme: mechanism of action, properties, classification, factors affecting activity, regulation, diagnostic value, therapeutic applications, and diseases caused by enzyme defects; Carbohydrate metabolism: glycolysis, the tricarboxylic acid (TCA) cycle, glycogen metabolism, diabetes mellitus, gluconeogenesis, the hexose monophosphate (HMP) shunt, and G6PD deficiency. Lipid metabolism, triacylglycerol metabolism, cholesterol synthesis and degradation, lipoproteins, and hyperlipidemias; Amino acid metabolism: nitrogen disposal, the urea cycle, and metabolism of individual amino acids with reference to metabolic diseases; phenylketonuria, maple syrup urine

disease, alkaptonuria, albinism, and homocystinuria; Amino Acids: Specialized products and related disorders; heme synthesis, porphyrias, jaundice, catecholamines, serotonin, dopamine, melanin, histamine synthesis, and associated disorders; Nucleic acids, DNA and RNA, structure, organization, and biological roles, while translation and the genetic code, the overview of genetic coding, protein synthesis, and the process of translation; Micronutrients and vitamins: water-soluble vitamins like vitamin C, thiamine, niacin, riboflavin, pyridoxine, pantothenic acid, folic acid, biotin, and cobalamin, their metabolism, biochemical functions, and clinical relevance; Fat-soluble vitamins A, D, E, and K: metabolism, biochemical functions, clinical significance, and stability under different storage conditions; Minerals and their biochemical roles: calcium, phosphorus, magnesium, sodium, chloride, potassium, copper, iron, zinc, manganese, chromium, fluorine, and ultra-trace minerals like iodine, their metabolism, absorption, transport, biochemical functions, clinical relevance, disorders associated with deficiency or excess, nutritional assessment, laboratory diagnosis, and the role of supplementation in disease prevention.

Practical:

Introduction to biochemistry Lab (Equipment); Units of measurement; pH meter/ Determination of pH & pOH; Demonstrate action of buffer; Tests for Carbohydrates- Benedicts test; Iodine test; Tests for Proteins- Biuret test, Xanthropeoetic test; Tests for Lipids- Solubility of Lipids; Cholesterol Crystals; Salkowski's test; Urine Analysis; Heat Coagulation Test; Benedicts Test; Report reading of different estimation tests.

Suggested Readings

Textbooks:

1. Ahmad, M. 2000. Essentials of Medical Biochemistry, 7th ed. Ilmi Book House, Urdu Bazar, Lahore.

Reference Books:

1. Nelson, D.L. and M.M. Cox. 2013. Lehninger Principles of Biochemistry, 6th ed. W.H. Freeman & Co Ltd., New York, USA.
2. Rodwell, V.W., D.A. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil. 2012. Harper's Illustrated Biochemistry, 30th ed. The McGraw-Hill Education, New York, USA.