BAREILLY INTERNATIONAL UNIVERSITY

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Course Work - Ph. D.

Syllabus – Faculty of Medicine

Paper-II (100 Marks)

Biochemistry (Code – 91126)

Credits : 04
Hrs. : 60

UNIT-I

Ionization of water, the concept of acid and base, weak acids and bases, pH, pK, Henderson Hasselbalch equation, buffer and buffering capacity.

Proteins: Classification, structure, properties and functions of amino acids and peptides, biologically important peptides, Classification, biological significance and structural organization of proteins, Structure-function relationship of proteins (hemoglobin, myoglobin, collagen and immunoglobulins), Fractionation, purification, structural analysis and characterization of proteins, Protein folding and its associated disorders, Protein denaturation, Plasma proteins.

Carbohydrates: Classification, biomedical importance, functions, properties and reactions of carbohydrates, Structural aspects of monosaccharides, disaccharides and polysaccharides, Mucopolysaccharides/ glycosaminoglycans, glycoproteins and glycolipids, Glycation, glycosylation and role of carbohydrates in blood group substances.

Lipids: Types, properties and biomedical importance of lipids, Fatty acids - nomenclature, classification, properties, reactions including essential fatty acids, polyunsaturated fatty acids and trans fatty acids, Trans fats, Cholesterol - structure, properties and biomedical importance,
Phospholipids – classification, properties, composition, and biomedical importance of various phospholipids, Glycolipids – classification, properties, composition, and biomedical importance, including the role of apoproteins, their importance in health and disease, Role of lipids in the structure and function of biological membranes, Structure, properties, and biomedical applications of micelles and liposomes.

Nucleotides and Nucleic Acids: Purine and pyrimidine bases in DNA and RNA, Nucleosides and nucleotides, Biologically important nucleotides (including synthetic analogs of purine/pyrimidine bases and nucleosides used as therapeutic agents), Structure, functions, properties, and types of DNA and RNA.

UNIT-II

PRINCIPLES OF BIOPHYSICS AND ITS BIOMEDICAL IMPORTANCE
Diffusion, osmosis, dialysis, surface tension, viscosity, colloids, crystalloids.

Cell Biology: Structural organization and functions of a biological cell and different subcellular organelles along with their marker enzymes, Molecular organization, functions, and structure-function relationship of a cell membrane, Solute transport across biological membranes with related disorders, Cell fractionation and separation of organelles, Disorders related to cell membrane and subcellular organelles, Intracellular traffic and sorting of proteins, Intracellular signaling pathways, membrane receptors and second messenger, Intercellular junctions, cellular adhesion molecules, intercellular signaling and communication, Extracellular matrix: composition, and biomedical importance, Cell cycle, its regulation, and mechanism of cell death.

UNIT-III

FLUID, ELECTROLYTE, AND ACID-BASE BALANCE

Fluid, electrolyte, and acid-base balance, mechanism of regulation and associated disorders.

ANALYTICAL TECHNIQUES AND INSTRUMENTATION

Colorimetry, Spectrophotometry, Atomic absorption spectrophotometry, Flame photometry, Fluorometry, Turbidimetry and nephelometry, Electrochemistry (pH electrodes, ion-selective electrodes, gas-sensing electrodes, enzyme electrodes), Chemiluminescence, Water quality testing (TDS, pH, fluoride) for autoanalyzer, Electrophoresis (principle, types, applications; isoelectric focusing, capillary electrophoresis; Chromatography [principle, types (including high-performance liquid chromatography and gas chromatography Mass spectrometry, Immunochemical techniques, Techniques in molecular biology, Techniques to study in vivo metabolism (NMR, SPECT, PET scan, etc.), Radioisotope-based-techniques and their applications (permissions, precautions, management of radioactive waste).

Enzymes: Properties, classification, mechanism of action, coenzymes and cofactors, proenzymes, ribozymes, nanozymes, catalytic antibodies, Factors affecting the rate of enzyme-catalyzed reaction, Kinetics of enzyme activity, regulation of enzyme activity, Isoenzymes and isoforms, role in metabolic regulation, Enzyme inhibition, Principles of enzyme assays, Applications of enzymes: diagnostic, therapeutic and commercial uses of enzymes.

Bioenergetics: Basic concepts of thermodynamics and its laws, as applicable to living systems Exergonic and endergonic reactions and coupled reactions, redox potential, High energy compounds, Enzymes of biological oxidation, Cytochromes.

Biological oxidation: Components, complexes and functioning of the respiratory chain including inhibitors, Process and regulation of oxidative phosphorylation including uncouplers, Mechanisms of ATP synthesis and regulation, Mitochondrial transport systems and shuttles.

UNIT-IV

INTERMEDIARY METABOLISM AND INBORN ERROR OF METABOLISM

Metabolism of carbohydrates: Digestion and absorption including associated disorders, Glycolysis and TCA (Kreb's cycle), including regulation, Glycogen metabolism and its regulation, Cori cycle, gluconeogenesis, Metabolism of fructose and galactose and their clinical significance, Pentose phosphate /HMP shunt pathway and uronic acid pathways and their clinical significance, Polyol/sorbitol pathway, Regulation of blood glucose, hyperglycemia, hypoglycemia and their clinical significance, Glucose tolerance test and its interpretation, Diabetes mellitus – classification, pathogenesis, metabolic derangements and complications, diagnostic criteria and laboratory investigations, Inborn errors and disorders of carbohydrate metabolism.

Metabolism of Lipids: Digestion and absorption and associated disorders, Metabolism of fatty acids, regulation and related disorders, Metabolism of eicosanoids and their clinical significance, Metabolism of triacylglycerol, storage and mobilization of fats, Metabolism of adipose tissue and its regulation, Metabolism of cholesterol including its transport and hypercholesterolemia, Metabolism of lipoproteins, atherosclerosis, fatty liver and lipid profile, Metabolism of methanol and ethanol.

Metabolism of amino acids and proteins: Digestion, absorption and associated disorders, Deamination, transamination, disposal of the amino group, catabolism of the carbon skeleton of amino acids, Formation and disposal of ammonia (including urea cycle) and related disorders, ammonia toxicity, Metabolism of individual amino acids and associated disorders, One carbon metabolism, Biogenic amines, Inborn errors of amino acid metabolism.

Metabolism of nucleotides: Metabolism of purines and pyrimidines and their associated disorders. Metabolism of haem: Metabolism of haem and associated disorders.

UNIT-V

NUTRITION

Calorific value, Basal Metabolic Rate (BMR), Specific dynamic action (SDA) of food. Nutritional importance of proximate principles of food including sources and RDA. Glycemic index. Biological value of proteins and nitrogen balance. Thermogenic effect of food. General nutritional requirements.

Balanced diet, diet formulations in health and disease, mixed diet. Calculation of energy requirements and prescribing diet.

VITAMINS AND MINERALS

Structure, functions, sources, RDA, and metabolism of vitamins and minerals and their associated disorders.

DETOXIFICATION AND METABOLISM OF XENOBIOTICS FREE RADICALS AND ANTI-OXIDANT DEFENSE SYSTEMS

Free radicals and anti-oxidant defense systems in the body. Associations of free radicals with disease processes.

UNIT-VI

MOLECULAR BIOLOGY

Structure and organization of chromosomes, DNA replication in prokaryotes and eukaryotes, DNA repair mechanisms and their associated disorders. Inhibitors of DNA replication and their clinical significance.

Transcription:

Structure of a gene - exons and introns, promoter, enhancers/repressors and response Process of transcription in prokaryotes and eukaryotes. Post-transcriptional modifications. Inhibitors of transcription.

Genetic code, gene polymorphism, and mutation:

Characteristics of the genetic code. Molecular basis of the degeneracy of the genetic code (Wobble hypothesis). Mutation and gene polymorphism. Mutagens- examples of physical, chemical, and biological mutagens. Types of mutations.

Translation:

Basic structure of prokaryotic and eukaryotic ribosomes. Process of protein synthesis (translation) in prokaryotes and eukaryotes. Post-translational modifications. Protein sorting, protein targeting, protein folding and related disorders.