DETAILED SYLLABUS FOR THE POST OF BIOCHEMIST IN MEDICAL EDUCATION DEPARTMENT

(CAT.NO.: 232/2024)

(Total Marks : 100)

I. TECHNIQUES IN BIOCHEMISTRY (20 MARKS)

Microscopy- Basic principles, instrumentation and applications of microscopy. Bright field, Phase-contrast, Fluorescence and Confocal Microscopy, Electron Microscope – Scanning and Transmission Electron Microscopy, Atomic Force Microscopy. Histopathology – definition, fixation, decalcification, tissue processing, cutting, staining and analysis.

Electrophoresis: Basic principles, instrumentation and applications of electrophoresis. Factors affecting electrophoresis. Electrophoretic techniques – Agarose gel, SDS-PAGE, Capillary, 2-D and Pulsed field.

PCR and Immunological techniques: DNA amplification by PCR - Conventional, Reverse-Transcriptase, Inverse, Quantitative Real-time, Nested and Multiplex PCR. Primer designing.

Spectroscopy: Principle, Concept of absorptions, transmission, scattering, phosphorescence, fluorescence, luminescence, diffraction spectra. Principle, instrumentation, working and application of UV, Visible and IR spectroscopy, spectrofluorimetry, flame photometry, atomic absorption spectrometry, luminometry.

NMR and mass spectrometry: Principle, instrumentation, working and application of Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR), Mass spectrometry - GC-MS, HPLC-MS and LC-MS/MS, Matrix-assisted laser desorption/ionization, Time- of Flight Mass spectroscopy (MALDI-TOF MS), X-ray crystallography.

Chromatography: Basic principles, Instrumentation, working and applications of partition chromatography (Paper), adsorption chromatography (TLC, HPTLC, different types of columns), affinity chromatography, ion exchange chromatography, gel filtration chromatography, gas-liquid chromatography (GLC), high pressure liquid chromatography (HPLC).

II. ENZYMOLOGY (20 MARKS)

Nomenclature and classification of enzymes. Energy of activation and its significance. Enzyme specificity, measurement and expression of enzyme activity - Definition of Unit, international unit (IU), katal. Coenzymes- classification - vitamin and nonvitamin coenzymes. Mechanism of enzyme action- Active site, Mechanism of enzyme action - general acid-base catalysis, covalent catalysis, proximity and orientation effects, role of metal ion in enzyme catalysis, mechanism of serine proteases - chymotrypsin, lysozyme, and ribonuclease.

Enzyme kinetics

Order of reaction, progress curve for enzyme catalyzed reactions. Factors affecting the velocity of enzyme catalyzed reaction - enzyme concentration, temperature, pH, inhibitors and activators, Michaelis-Menten equation; Km and Vmax values and their significance, Lineweaver-Burk plot and its physiological significance. Enzyme inhibition – competitive, non-competitive, uncompetitive and mixed. Allosteric and feedback inhibition with examples, suicide inhibition. Dose-response curves of enzyme inhibition. Regulation of enzyme activity-covalent regulation, allosteric regulation, Feedback regulation. Multienzyme complex- Mechanism of action and regulation.

Enzyme Technology- Isolation and purification of enzymes and criteria of purity- specific activity. Industrial and therapeutic uses of enzymes. Immobilization of enzymes and their applications. Designer enzymes - Abzymes, Ribozymes. Serum enzymes in health and disease-diagnostic and therapeutic applications.

III. QA, QC AND GLP (15 MARKS)

Quality Assurance- Their functions and advantages, Concept of Quality, Control Quality Standards- Advantages and Disadvantages. Good laboratory practices, WHO guidelines on GLP and GMP, Quality assurances in Good Laboratory Practices.

QA QC in Clinical Laboratory

Quality assurance and Quality Control with reference to clinical laboratory, Factors influencing quality. Quality assurance cycle: Pre analytic, analytic and post analytic. QC procedures. Internal quality control and external quality control. Types of errors: Random Error, systematic error. Reasons for laboratory errors. Quality system essentials. Overview of statistics including, calculation of mean, standard deviation and probability. Monitoring QC data, Levey-Jennings Chart, Westgard rules. Clinical audit of the laboratory, Trouble shooting.

IV. CLINICAL BIOCHEMISTRY (20 MARKS)

Specimen collection and automation Specimen collection and processing: Blood collection methods, anticoagulants. Cerebrospinal fluid (CSF): Composition and collection, gross examination, cell counts, chemical examination and bacteriologic examination. Amniotic fluid: Origin, collection, composition and routine analysis of amniotic fluid. Collection and examination of Synovial fluid, Pleural fluid, Pericardial fluid and Peritoneal fluid. Collection of urine: Timed urine specimens, urine preservatives. Basic concepts and definitions of automation in the clinical laboratory. Multifunction Workstations (Automated Specimen Processing), Total Laboratory Automation Systems. Post assay processing, Signal processing, Data handling and Process control, Instrument clusters, Microtiter plate systems, Automated pipetting stations.

Clinical Enzymology: Principles of diagnostic enzymology, Factors affecting enzyme levels in blood. Principle, assay, and clinical significance of transaminases, creatine kinase, lactate, Dehydrogenase, phosphatases, 5'nucleotidase, gamma –glutamyl transferase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase and glucose -6-phosphate dehydrogenase. Enzyme pattern in diseases: Myocardial infarction, hepatobiliary diseases.

Organ function tests and related disorders: Liver function test and related disorders: Jaundice, cirrhosis, hepatitis, fatty liver and gall stones. Renal function test and related disorders: Acute renal failure. glomerular disease, tubular diseases, analysis of urinary calculi. Gastric and pancreatic function tests. Hyper and hypo lipoproteinemia's and diagnostic test for lipoprotein disorders. Atherosclerosis, Diabetes, Cancer, Inflammatory arthritis, Obesity – Risk factors, Molecular pathogenesis, Biochemical and clinical features, diagnosis, treatment.

V. MOLECULAR ENDOCRINOLOGY (15 MARKS)

Classification of hormones, overview of circulation, modification and degradation. Target tissue feedback control. Hormone receptors - general features, structure and regulation. Mechanism of hormone action. Synthesis, secretion, transport, metabolic fate, biological actions, mechanism of action, functions and regulation of hormones secreted by the Hypothalamus and Pituitary, Thyroid, Pancreas, adrenal and Gastrointestinal hormones. Endocrine disorders and their detection methods. Thyroid function tests. Hormones and human health.

VI. PHARMACOLOGY (10 MARKS)

Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50.

Pharmacokinetics- Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney.

Clinical Toxicology: Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism and synergism. Methods of detection. Drug abuses and their biological effects. Clinical symptoms of toxicity and marker parameters.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.