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GOVERNMENT OF JAMMU & KASHMIR
**SHER-I-KASHMIR INSTITUTE OF MEDICAL SCIENCES**
SOURA SRINAGAR

# Syllabus for Assistant Professor Posts of the Department of Clinical Biochemistry, SKIMS, SOURA.

# SYLLABUS ASSISTANT PROFESSOR (BIOCHEMISTRY)

## UNIT I: CELL BIOLOGY AND GENERAL BIOCHEMISTRY

- Cell structure and function
- Biomembranes and membrane transport
- Cell organelles and cytoskeleton
- Cell signaling and receptors
- Water and electrolyte balance
- pH, buffers, Henderson-Hasselbalch equation
- Osmosis, diffusion, surface tension
- Colloids and laws of mass action

## UNIT II: ENZYMOLOGY

- Classification and nomenclature of enzymes
- Enzyme kinetics and Michaelis-Menten equation
- Factors affecting enzyme activity
- Enzyme inhibition and activation
- Regulation of enzyme activity
- Isoenzymes and diagnostic significance
- Clinical enzymology
- Therapeutic applications of enzymes

## UNIT III: PROTEIN AND AMINO ACID METABOLISM

- Chemistry and classification of amino acids
- Structure and function of proteins
- Plasma proteins and immunoglobulins
- Structural proteins: collagen, elastin, keratin
- Contractile proteins
- Glycoproteins and proteoglycans
- Hemoglobin structure and function
- Hemoglobinopathies and thalassemias
- Heme synthesis and degradation
- Porphyrias and jaundice
- Amino acid metabolism
- Inborn errors of amino acid metabolism
- Protein folding disorders and prion diseases

## UNIT IV: CARBOHYDRATE METABOLISM

- Chemistry and classification of carbohydrates

- Glycolysis
- Glycogenesis and glycogenolysis
- Gluconeogenesis
- Pentose phosphate pathway
- TCA cycle
- Electron transport chain and oxidative phosphorylation
- Regulation of blood glucose
- Diabetes mellitus and complications
- Glycogen storage diseases
- Galactosemia and fructose metabolism disorders
- Inborn errors of carbohydrate metabolism

## UNIT V: LIPID METABOLISM

- Chemistry and classification of lipids
- Fatty acid oxidation and synthesis
- Ketone body metabolism
- Cholesterol metabolism
- Lipoproteins and dyslipidemias
- Eicosanoids and prostaglandins
- Fatty liver
- Obesity and metabolic syndrome
- Atherosclerosis
- Lysosomal storage diseases
- Inborn errors of lipid metabolism

## UNIT VI: NUCLEIC ACIDS AND MOLECULAR BIOLOGY

- Structure and function of DNA and RNA
- DNA replication and repair
- Transcription and translation
- Regulation of gene expression
- Epigenetics
- Cell cycle and apoptosis
- Oncogenes and tumor suppressor genes
- Molecular basis of cancer
- Tumor markers
- Mitochondrial genetics
- Recombinant DNA technology
- PCR and Real-Time PCR
- DNA sequencing
- Southern, Northern and Western blotting
- RFLP and DNA fingerprinting
- CRISPR and gene editing
- Gene therapy
- Stem cell biology

- RNA interference
- DNA microarray
- Prenatal and neonatal molecular diagnosis
- Basics of bioinformatics

## UNIT VII: IMMUNOLOGY

- Innate and Adaptive Immunity
- Antigens, Antibodies and Immunoglobulins
- Antigen-Antibody Reactions and Complement System
- Major Histocompatibility Complex (MHC) and Antigen Presentation
- Hypersensitivity Reactions
- Autoimmune Diseases
- Immunodeficiency Disorders
- Transplantation Immunology
- Tumor Immunology
- Monoclonal Antibodies and Their Applications
- Vaccines and Immunization
- Laboratory Diagnosis of Immunological Disorders

## UNIT VIII: NUTRITION, VITAMINS AND MINERALS

- Principles of Nutrition, Balanced Diet and Nutritional Requirements
- Digestion, Absorption and Metabolism of Nutrients
- Energy Metabolism, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ) and Specific Dynamic Action (SDA)
- Protein-Energy Malnutrition (PEM), Obesity and Nutritional Disorders
- Vitamins: Classification, Sources, Metabolism, Biochemical Functions, Recommended Dietary Allowances (RDA), Deficiency Disorders and Toxicity
- Minerals and Trace Elements: Sources, Requirements, Biochemical Functions, Deficiency and Excess States
- Nutritional Assessment and Laboratory Evaluation of Nutritional Disorders
- Free Radicals, Oxidative Stress and Antioxidants
- Xenobiotics, Biotransformation and Detoxification Mechanisms.

## UNIT IX: ENDOCRINOLOGY

- Hormone Classification, Biosynthesis, Secretion, Transport, Metabolism and Mechanism of Action
- Hypothalamic and Pituitary Hormones
- Thyroid and Parathyroid Hormones
- Pancreatic Hormones and Glucose Homeostasis
- Adrenal Cortical and Medullary Hormones
- Gonadal Hormones and Reproductive Endocrinology

- Gastrointestinal Hormones and Neuroendocrine Peptides
- Reproductive Biochemistry: Ovulation, Fertilization, Pregnancy and Lactation
- Infertility, Assisted Reproductive Technologies and Contraception
- Endocrine Regulation of Metabolism and Endocrine Interrelationships
- Disorders of Thyroid, Parathyroid, Pituitary, Adrenal and Gonadal Function
- Diabetes Mellitus and Other Endocrine Metabolic Disorders
- Endocrine Tumors and Multiple Endocrine Neoplasia Syndromes
- Laboratory Diagnosis and Hormonal Evaluation of Endocrinopathies
- Dynamic Endocrine Function Tests and Interpretation of Hormonal Assays.

## UNIT X: CLINICAL BIOCHEMISTRY

- Organ Function Tests: Liver Function Tests (LFT), Renal Function Tests (RFT), Thyroid Function Tests (TFT), Pancreatic Function Tests, Cardiac Function Tests, Gastrointestinal Function Tests, Acid-Base Disorders and Blood Gas Analysis
- Body Fluid Analysis: Cerebrospinal Fluid (CSF), Pleural Fluid, Peritoneal Fluid, Pericardial Fluid, Synovial Fluid and Semen Analysis
- Metabolic and Endocrine Disorders: Diabetes Mellitus, Metabolic Syndrome, Dyslipidemias, Obesity, Electrolyte Disorders, Calcium, Phosphate and Magnesium Disorders
- Cancer Biochemistry and Tumor Markers: Cancer Screening, Diagnosis, Prognosis and Monitoring
- Pregnancy and Reproductive Biochemistry: Pregnancy Tests, Fetoplacental Function Tests and Infertility Evaluation
- Bone and Mineral Metabolism: Bone Metabolism Markers and Metabolic Bone Disorders
- Cardiac Biomarkers and Laboratory Evaluation of Cardiovascular Diseases
- Sepsis Biomarkers, Inflammatory Markers and Acute Phase Reactants
- Therapeutic Drug Monitoring (TDM) and Clinical Toxicology
- Laboratory Diagnosis of Infectious Diseases including HIV/AIDS and Viral Hepatitis
- Laboratory Evaluation of Autoimmune Diseases and Immunological Disorders
- Metabolic Liver Diseases, Non-Alcoholic Fatty Liver Disease (NAFLD) and Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD)
- Laboratory Evaluation of Inborn Errors of Metabolism
- Clinical Interpretation of Biochemical Investigations and Case-Based Laboratory Diagnosis.

## UNIT XI: BIOCHEMICAL AND MOLECULAR TECHNIQUES

- Chromatographic Techniques: Paper Chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC)
- Electrophoretic Techniques: Protein Electrophoresis, Lipoprotein Electrophoresis, Hemoglobin Electrophoresis, Isoelectric Focusing
- Spectroscopic Techniques: Colorimetry, Spectrophotometry, Fluorometry, Flame Photometry, Atomic Absorption Spectrometry, Chemiluminescence

- Immunological Techniques: ELISA, CLIA, RIA, Immunofixation, Nephelometry, Turbidimetry, Flow Cytometry
- Molecular Diagnostic Techniques: PCR, RT-PCR, Real-Time PCR (qPCR), DNA Sequencing, Fluorescence In Situ Hybridization (FISH), Microarray Technology, Next Generation Sequencing (NGS), Molecular Biomarkers
- Radioisotope Techniques and Applications in Biomedical Research
- Automation and Instrumentation: Clinical Chemistry Analyzers, Immunoassay Analyzers, Blood Gas Analyzers, HbA1c Analyzers, Point-of-Care Testing (POCT) Devices
- Laboratory Informatics, Laboratory Information Systems (LIS) and Digital Laboratory Technologies.

## UNIT XII: QUALITY ASSURANCE, ACCREDITATION AND LABORATORY MANAGEMENT

- Internal Quality Control (IQC)
- External Quality Assessment Scheme (EQAS)
- Westgard Rules and Levey-Jennings Charts
- Method Validation and Verification
- Reference Intervals and Biological Variation
- Laboratory Accreditation: ISO 15189, NABL Guidelines, CAP Standards
- Good Laboratory Practices (GLP) and Good Clinical Laboratory Practices (GCLP)
- Biosafety, Biosecurity and Biomedical Waste Management
- Inventory and Reagent Management
- Equipment Calibration, Maintenance and Troubleshooting
- Laboratory Audits and Risk Management
- Laboratory Ethics and Regulatory Compliance
- Automation in Clinical Laboratories
- Laboratory Information Systems (LIS)
- Pre-analytical, Analytical and Post-analytical Quality Assurance
- Critical Value Reporting and Turnaround Time (TAT) Monitoring.

## UNIT XIII: BIOSTATISTICS AND RESEARCH METHODOLOGY

- Types of data and measurement scales
- Data collection, classification and presentation
- Measures of central tendency and dispersion
- Probability and probability distributions
- Sampling techniques and sample size determination
- Hypothesis testing and confidence intervals
- **Parametric tests:** Z-test, Student's t-test (paired and unpaired), ANOVA, Pearson correlation, linear regression
- **Non-parametric tests:** Chi-square test, Fisher's exact test, Mann-Whitney U test, Wilcoxon signed-rank test, Kruskal-Wallis test, Friedman test, McNemar test, Spearman rank correlation, Kendall's Tau

- Diagnostic test evaluation: Sensitivity, specificity, predictive values, likelihood ratios, ROC curve and AUC
- Epidemiological measures: Incidence, prevalence, relative risk, odds ratio, attributable risk
- Research methodology: Study designs, clinical trials, Good Clinical Practice (GCP), evidence-based medicine
- Systematic reviews and meta-analysis
- Research ethics, publication ethics and scientific writing