DEPARTMENT OF BIOCHEMISTRY
UNIVERSITY OF KASHMIR

PhD (Integrated) Entrance Test Syllabus for Biochemistry
(Effective from 2018)
# Syllabus for PhD (Integrated) Entrance Test in Biochemistry
(Effective from 2018)

(The syllabus is based on core papers in MSc Biochemistry programme in effect since 2017)

## Core Papers

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(Detailed syllabus on next page)
1. **Biomolecules**

**Unit-I**
Carbohydrates
Definition, classification, characterization and biological importance of mono- and disaccharides
- Structure and conformation of sugars
- Stereo- and optical isomerisms
- Structure and function of homo- and heteropolysaccharides
- Mucopolysaccharides and proteoglycans
- Chemical reactions of functional groups present in carbohydrates

**Unit-II**
Lipids
- Classification of lipids
- Chemical composition and properties of triglycerides
- Nomenclature and properties of saturated and unsaturated fatty acids
- Properties and functions of phosphoglycerides and sphingolipids
- Structure and functions of steroids (cholesterol and bile acids)
- Prostanoids

**Unit-III**
Amino acids
- Structure, classification and physiochemical properties
- Essential and non-essential amino acids
- Characteristics of a peptide bond
- Oligo-peptides and polypeptides
- Chemical synthesis of a peptide

Proteins
- Levels of protein structure
- Elucidation of primary structure
- Forces stabilizing the tertiary structure
- Protein denaturation and renaturation

**Unit- IV**
Nucleic Acids
- Primary, secondary and tertiary structure of DNA
- Various forms of DNA, structural polymorphism of DNA
- Properties of DNA
- Denaturation and annealing of DNA, Cot Curve
- DNA as a genetic material
- Primary, secondary and tertiary structure of RNA
- Functions of various types of RNA

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2. **Cell Biology**

**Unit-I**
Basic properties of cells
Structural organization of prokaryotic and eukaryotic cells
Introduction of viruses
Cell membrane
  - Chemical composition
  - Structure and function of membrane proteins
  - Membrane lipids and membrane fluidity
  - Dynamic nature of plasma membrane
  - Movement of substance across cell membrane
  - Membrane potentials
Mitochondria
  - Structure and function
  - Oxidative metabolism in mitochondria
  - Role of mitochondria in ATP formation
  - Translocation of protons and establishment of a proton motive force

**Unit-II**
Introduction to endomembrane system
Approaches to study endomembrane
Endoplasmic reticulum, structure, functions
Golgi complex
Types of vesicle transport and their types
Lysosomes and plant vacuoles, peroxisomes
Moving membranes and materials into the cell interior
Posttranslational uptake of proteins by peroxisome, mitochondria and chloroplasts

**Unit-III**
Cell wall
  - Detailed structure and functions of Cell wall
  - Microbodies
Chloroplast
  - Structure, function
  - Photosynthetic units and reaction centers
  - Photophosphorylation

**Unit IV**
Extracellular matrix and cell interaction
  - Extracellular space
  - Interaction of cells with extracellular material
  - Tight Junction- sealing the extracellular space
  - Cell -cell adhesion
  - Cell -cell communication
The cytoskeleton
  - Microtubules
  - Intermediate filaments
  - Microfilaments

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3. **Metabolism**

**Unit-I**
Bioenergetics
- Energy transformation by biological systems
- Concept and significance of free energy
- Phosphoryl transfer potential
- Coupled reactions
- ATP as energy currency
- Metabolon concept

**Unit-II**
Carbohydrate metabolism
- Glycolysis
- Citric acid cycle, its function in energy generation and biosynthesis of energy rich-bonds
- Pentose phosphate pathway and its regulation
- Alternate pathways of carbohydrate metabolism
- Gluconeogenesis
- Biosynthesis of glycogen and starch

**Unit-III**
Lipid metabolism
- Fatty acid oxidation- $\alpha$, $\beta$, $\omega$, oxidation and lipo-oxidation.
- Fatty acid biosynthesis- Acetyl CoA carboxylase, Desaturase and elongase
- Biosynthesis of triacylglycerols, Phosphoglycerides and sphingolipids
- Biosynthetic pathways for terpenes, steroids and prostaglandins
- Ketone bodies- Formation and utilization

**Unit-IV**
Regulation of carbohydrate and lipid metabolism -hormonal/enzymatic
- Interactions between carbohydrate and lipid metabolism – role of insulin and adiponectin
- Inborn errors of carbohydrate and lipid metabolism
4. **Molecular Biology**

**Unit-I**
Replication
- Unit of replication,
- Replication Origin and Replication Fork
- Enzymes involved in replication,
- Initiation, Elongation and Termination of Replication
- Fidelity of Replication,

**Unit-II**
Transcription
- Transcription in prokaryotes and eukaryotes
- Transcriptional factors and their role
- RNA polymerases
- Formation of initiation complex
- Elongation and termination
- Inhibitors of transcription
- RNA processing, splicing, polyadenylation, capping
- Structure and function of different types of RNA's

**Unit-III**
Regulation of gene expression
- Prokaryotes
- Eukaryotes
- Viruses
- Transcriptional activators and repressors
- Role of chromatin in regulating gene expression and gene silencing
- Epigenetics and its importance in regulation of gene expression

**Unit- IV**
Translation
- Protein synthesis and genetic code
  - General characteristics of genetic code
  - Deciphering of genetic code
- Ribosomes as the site of protein synthesis, polysomes
- Activation of amino acids
- Chain initiation, elongation and termination in prokaryotes and eukaryotes
- Control of translation (Role of Guanine nucleotides).
- Translational fidelity, Kinetic proof reading
- Positive and negative regulation of translation
- Inhibitors of protein synthesis
5. Physiology And Clinical Biochemistry

Unit-I Hematology
Composition of blood
Mechanism and regulation of blood coagulation, fibrinolysis
Neuro-muscular system
Mechanism of conduction of nerve impulse along axon, neurotransmitters
Biochemistry of vision
Ultra structure and molecular mechanism of contraction of skeleton and smooth muscles and its regulation

Unit-II
Gastrointestinal physiology
Digestion and absorption
Gastrointestinal disorders
Excretory system
Formation of urine
Normal and abnormal constituents of urine

Unit – III
Introduction to clinical biochemistry
Water and electrolyte balance
Regulation of water and electrolyte balance, role of kidney and hormones
Acid base balance regulation by human body, concept of metabolic and respiratory acidosis and alkalosis

Unit – IV
Principles of diagnostic enzymology
Evaluation of organ function tests
Clinical presentation and diagnosis of renal, hepatic and pancreatic diseases
Cardiac function tests and Thyroid function tests
Diagnostic significance and interpretation of glucose tolerance test
Diagnostic tests for Apo lipoproteins, HDL cholesterol, LDL cholesterol and triglyceride disorders

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6. Immunology

Unit-I
Historical perspective, terms associated with immunology, Antigenicity, Features of Antigeneticiy, super antigens, adjuvants.
Cells of immune system: Myeloid, Mononuclear cells, T-Lymphocytes, B-Lymphocytes, NK-Cells
Primary and secondary lymphoid organs: Thymus, Bursa of fabricus, Peyers Patch, spleen, lymph nodes, mucosal associated and cutaneous associated lymphoid tissues.

Unit - II
Immunoglobulin, structure, classes and subclasses
Multigene organization of Ig gene, variable region gene rearrangements, allelic exclusion, generation of diversity of Ig, Assembly and secretion of Ig, class switch, regulation of Ig transcription.
Humoral and cell mediated immunity: B cell development and activation, BCR, T cell development and activation, TCR.
Regulation of system: complement cascade, Biological function and its regulation, Complement fixation test.
Introduction to cytokines.

Unit - III
Major histocompatibility complex: different classes, organization and biological function. Transcription regulation of MHC
Hypersensitivity: Type I, II, III, and IV
Autoimmunity and autoimmune diseases
Single organ and systemic autoimmune diseases
Brief introduction to Primary and secondary immunodeficiencies, AIDS
Mechanisms of transplantation. Examples of organ transplantation.
Examples of immune response to Viruses, bacteria, protozoa, fungal and helminthic infection

Unit-IV
Immunoblotting and diagnosis of various important diseases, only infectious and few cancerous types
Techniques – ELISA, RIA, fluorescent IA, agglutination of pathogenic bacteria, Haemagglutination and its inhibition. Affinity, avidity
Immunoelectron microscopy
Enumeration of total T-cell numbers by sRBC, resetting technique
Determination of total number of B-lymphocytes by staining for surface IgG.
Antigen – antibody interaction and its applications.
Total hemolytic assay

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