



Department of Biochemistry
(Research Centre of university of Kashmir)

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Syllabus 3-year integrated Ph.D Entrance Test in Biochemistry 2017

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SECTION 1

MAJOR BIOMOLECULES, ENZYMOLOGY AND INTERMEDIARY METABOLISM

Proteins :

Amino acids, their structure, classification and role. Peptide bond and Ramachandran plots. Primary, secondary, super secondary, domain level, tertiary and quaternary structure of proteins. Forces involved in their stabilization. Essential and non-essential amino. Folding of proteins role of chaperones and chaperonins. Protein misfolding and related disorders, prions. Plasma proteins, their classification and altered levels in diseases. Protein databases, Proteomics and its importance.

Enzymology:

Nature, Classification & Distribution of enzymes. Cofactors & Coenzymes. Factors affecting enzyme catalysed reactions. Significance of Km. Allosteric enzymes. Enzyme inhibition. Transition state Analogs & Suicide inhibitors. Isoenzymes. Clinical Enzymology.

Bioenergetics and biological oxidation

Energy transformation by biological systems. Concept and significance of free energy. Phosphoryl transfer potential. Oxidative phosphorylation. Structural organization of respiratory chain. OXPHOS diseases.

Carbohydrates and their metabolism

Introduction. Classification, structure, function and biological importance of carbohydrates including monosaccharides, disaccharides, oligo and polysaccharide. Importance of Glycoproteins, Mucopolysaccharides and proteoglycans. Glycomics and functional glycobiology : Glycolysis, TCA Cycle & their regulation, HMP Shunt pathway, Uronic acid pathway & their importance. Gluconeogenesis & its regulation. Glycogen metabolism & its regulation. Metabolism of Galactose & Fructose. Disorders of Carbohydrate metabolism.

Lipids and their metabolism

Classification, structure, function and biological importance of lipids including fatty acids, triacyl glycerols, phospholipids, sphingolipids, steroids. Structure and role of glycolipids, prostaglandins, thromboxanes and leukotrienes. Fatty acid oxidation & its Regulation. Biosynthesis, utilisation of Ketone bodies & their importance. Ketosis. Biosynthesis of Fatty acids & its regulation. Biosynthesis of Cholesterol, its inhibitors & its regulation. Fatty liver & lipotropic factors. Lipoproteins, their metabolism & disturbances in Lipoprotein metabolism. Biosynthesis of Bile Acids & Steroid Hormones.

Nucleic Acid and their metabolism

Primary, secondary and tertiary structure of DNA. Various forms of DNA, structural polymorphism of DNA. Properties of DNA. Denaturation and reannealing of DNA, Cot Curve, DNA as a genetic material. Extra chromosomal DNA Organelle genome Primary, secondary and tertiary structure of RNA Functions of various types of RNA Concept of small RNA's. Biosynthesis of Purines & Pyrimidines. Inhibitors of Purine & Pyrimidine biosynthesis, their use as anti-cancer drugs. Salvage of Purines & Pyrimidines, its importance. Deoxyribonucleotide

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biosynthesis & its importance. Catabolism of Purines with reference to uric acid metabolism & Gout. Catabolism of Pyrimidines.

Amino Acid Metabolism : Biosynthesis and degradation of amino acids and their regulation
Specific aspects of amino acid metabolism Urea cycle and its regulation In-born errors of amino acids metabolism

SECTION 2

MOLECULAR BIOLOGY AND IMMUNOLOGY

Detailed structural organization and functions of Cell and cellular organelles

Cell signaling:

Signaling molecules and their receptors. Functions of G-protein- coupled receptors, protein tyrosine kinase and cytokine receptors Pathways of intra cellular signaltransduction, signal transduction and cytoskeleton. Signaling in development and differentiation. Molecular intake and its impacts. Introduction of cell specialization and differentiation. Cell cycle Detailed molecular events in cell cycle. Regulation of cell cycle, cell proliferation in development and differentiation. Cell death/ Apoptosis and its regulation.

Replication and Transcription

Genomes, Genetic code & introduction to basic concepts of DNA & RNA metabolism. Replication, Transcription & Translation with E.Coli as prokaryotic prototype & differences in Eukaryotes. Inhibitors of Replication, Transcription & Translation in prokaryotes & eukaryotes & their importance. Translational fidelity, Kinetic proof reading Positive and negative regulation of translation Inhibitors of protein synthesis Brief description of post translational processing of polypeptide chains and associated signals for localization, trafficking and targeting Protein degradation by proteasomes. Epigenetics & RNA Interference. Principles & applications in Medicine of Recombinant DNA Technology, PCR & concept of Gene Therapy. Mitochondrial Genetics. Genomics & Bioinformatics, their relevance to Medicine.

Immunology

Innate and acquired immunity . Medical Importance of the Immune System Cells and Organs of the Immune System . Antigens and Immunogens Antigenicity. Immunoglobulin, structure, classes and sub classes 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. Compliment cascade, its regulation, biological functions, complement fixation test. Introduction to cytokines their different classes, organization and biological function. Transcription regulation of MHCH hypersensitive: Type I, II, III, and IV. Immune Regulation & Tolerance .Autoimmune diseases. Brief introduction to Primary and secondary immunodeficiencies, AIDS . Antibody Therapy



Regulation of Gene expression in Phages, viruses, prokaryotes and eukaryotes

Role of chromatin in regulating gene expression and gene silencing Concept of epigenetics and its importance in regulation of gene expression Small RNA and their roles Gene silencing Micro RNA, RNA caging, RNA interference, Gene knockout Concept and significance of polymorphism

Cancer biology

Hallmarks of cancer genetic and epigenetic basis of cancer Role of carcinogens and DNA repair in Cancer/ Tumor viruses, oncogenes and tumor suppressor genes. Cancer Immunology.

SECTION 3

BIOCHEMICAL TECHNIQUES AND BIOTECHNOLOGY

Centrifugation

Basic principle of centrifugation Factors affecting sedimentation Types of centrifugation including differential, density gradient and ultracentrifugation Analytical and preparative centrifugation Applications of centrifugation

Chromatographic techniques

Basic principle and application and applications of Gel filtration chromatography Affinity chromatography Gas chromatography High pressure liquid chromatography

Electrophoresis and related Techniques

Factors affecting electrophoretic mobility Types of electrophoresis. Application in molecular and protein biology Isoelectric focusing Polymerase chain reaction; Principle, Requirement, Variants and Applications Purification of PCR product RFLP, RAPD and AFLP techniques Single strand conformation polymorphism and heteroduplex analysis Gel retardation assays DNA Sequencing

Different blotting techniques

Detection of molecules using ELISA, RIA, immunoprecipitation, flowcytometry and immunofluorescence microscopy Detection of molecules in living cells, insitu localization by techniques such as FISH and GISH.

Methods for analysis of gene expression at RNA and protein level

Large scale expression analysis, such as micro array based techniques; Coimmuno precipitation and Chromatin immunoprecipitation DNA profiling, DNA foot printing

Recombinant DNA Technology Vectors

Plasmids, bacteriophages, phagemids, cosmids, YACs, and BACS vectors Methods of creating recombinant DNA Molecule. Transformation and screening of recombinant vector. Confirmation of insert. Expression strategies in different hosts, vector and host engineering Properties of restriction endonucleases and their mode of action and usefulness in genetic engineering and polymorphism studies Library construction and screening, cDNA and genomic libraries Primary, secondary and tertiary screening methods Identification of gene Protein production in bacteria



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Immunotechniques and Immunobiotechnology

Types of immunodiffusion and immunoelectrophoretic procedures, isoelectric focusing, affinity chromatographic methods and separation of immunoglobulin from serum. Immunoblotting and its role in diagnosis. only infectious and few cancerous types Techniques - ELISA, RIA, florescent IA, agglutination of pathogenic bacteria, Haemagglutination and its inhibition. Affinity, avidity Immunoelecton microscopy Enumeration of total T-cell numbers by RBC, resetting Determination of total number of B lymphocytes by staining for surface IgG. Antigen - antibody interaction and its applications.

Development of Monoclonal Antibodies by hybridoma Technology and role in medicine. Recombinant DNA technology and its applications. Vaccination: Conventional and genetically engineered Vaccines. Lymphokines - production and applications. Different media and their composition. Primary and established Cell lines. Biology and characterizations of the cultured cells. Introduction to balanced salt solutions and simple growth medium. Role of CO₂, serum and supplements. Serum and serum free defined media and their applications. Measuring parameters of growth. Properties of transformed cells. Immortalization and methods used to immortalize cells. Measurements of viability, cytotoxicity assay: Trypan blue, MTT, TUNNEL and ELISA based assays. Applications of Animal cell culture.

SECTION 4

CLINICAL BIOCHEMISTRY

Clinical Biochemistry Laboratory : Laboratory Management: Common hazards in the laboratory. Management of biological and radioactive wastes. Tests of significance. Selecting of an analytical method. Evaluation of an analytical method. Evaluation of a diagnostic test. Computer applications in clinical chemistry. Automation in clinical chemistry

Quality assurance in clinical laboratories Use of reference values Quality control programmes - external and internal QCs and QC methods. Point of care testing (POCT)
Basic principles of biostatistics as applied to health sciences:

Hydrogen ion homeostasis: Maintenance of pH Associated disorders, and laboratory diagnosis.
Fluid and electrolyte homeostasis: Maintenance of fluid and dectrolyte balance Associated disorders and laboratory diagnosis.

Diagnostic enzymology, including markers. Clinical enzymology : Enzymes of liver, cardiac and skeletal muscle. Laboratory diagnosis of myocardial infarction. Pancreatic enzymes. Tumor markers.

Diabetes mellitus . Including gestational diabetes mellitus. Role of biochemical and immunological tests in diagnosis and monitoring of diabetes mellitus. Diabetic ketoacidosis. Other metabolic complications of diabetes mellitus. Monitoring of treatment. Glycated proteins. Urinary albumin excretion. Hypoglycemia. Glucose tolerance & glucose tolerance test.

AMM 5

Disorders of lipoprotein metabolism. Laboratory diagnosis of these disorders. Association with atherosclerosis and the consequences. Serum lipid profile and its importance in medicine .
Life style diseases, Metabolic syndrome and laboratory evaluation

Proteins: Plasma proteins in health and disease. Proteins in other body fluids (urine, cerebrospinal fluid).

Investigation of hepatobiliary function and jaundice .Biochemical liver function tests
Disorders of renal function, including acute and chronic renal failure. Laboratory assessment of renal function

Laboratory assessment of gastrointestinal function: Gastric function tests. Pancreatic function tests. Intestinal function tests.

Mineral and bone metabolism: Laboratory assessment of rickets, osteomalacia, osteoporosis. Markers for osteoblasts and osteoclasts. Hyper and hypocalcemia. Disorders of magnesium.

Disorders of porphyrin metabolism: Laboratory assessment of porphyrias.

Disorders of hemopoietic system, Ferro kinetic studies, Hemoglobinopathies, porphyrias and their lab diagnosis.

Cerebrospinal and other body fluids: Analysis in health and disease.

Miscellaneous

Aminoacidurias, organic acidurias and their laboratory diagnosis .

Biochemical and immunological diagnosis of AIDS and other immunological disorders

Composition and analysis of calculi – salivary, renal and biliary system

Molecular methods in prenatal & new born screening, Markers of chromosomal aneuploidy in maternal serum (Quad screen). Nucleic acid testing (NAT) for foetal DNA in maternal circulation.

Endocrinology : Signal transduction due to neurotransmitters, hormones, growth factors, cytokines and rhodopsin. Mechanisms of hormone action by interaction with intracellular and membrane - associated receptors. Structure, functions, synthesis and regulation, metabolism, actions, associated disorders and laboratory assessment of various hormones produced by the hypothalamus, pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, gastrointestinal tract and gonads. Endocrine functions of kidney, heart, lungs and adipose tissue. Placental hormones.



Principle and application of

- a) Confocal Microscopy
- b) Phase contrast microscopy
- c) Scanning electron microscopy (SEM)
- d) Transmission electron microscopy (TEM)
- e) Ultra-microscopy

Principle and applications of molecular cloning

PAPER III: SPECIALIZED PAPER:

Paper shall be based on the topic of research of the student (100 marks)

Recommended books

1. Practical Skills in Chemistry, J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyersm and A Jones, Pearson Education Ltd. [Prentice Hall]
2. Henry a. Erlich, PCR Technology: Principles and Applications for DNA Amplification
3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Trevor Palmer, Philip L. R. Bonner
4. Principles and Techniques of Biochemistry- Wilson and Walker
5. Campbell RC Statistics for biologists
6. Methods in Biostatistics. by Dr K.S. Negi Essential MCQs on Biostatistics and Epidemiology:
7. Molecular cloning: a laboratory manual / Joseph. Sambrook, David W. Russell
8. Gilmore B, Plagiarism: Why it happens, How to prevent it
9. R Panneerselvam, Research Methodology
10. Shelly GB, Vermaat ME, Cashman TJ, Microsoft office: Introductory Concepts and Techniques
11. Snedecor GW & Cochran WG, Statistical Methods
12. Sokal RR & Rohlf FJ, Introduction to Biostatistics
13. Sood V, Cyber Law Simplified
14. <http://www.ncbi.nlm.nih.gov>