

## DETAILED SYLLABUS FOR HUMAN BIOCHEMISTRY FOR I M.B.B.S.

**Introduction:** Scope of Biochemistry, Biotechnology, Molecular Biology, Biochemical Concept of Health and Disease

**Biochemical Morphology of the Eukaryotic cell (Molecular and functional organization of cell and cellular organelles):** Composition, functions and structure of cell membrane, Transport systems across the cell membrane and their mechanism, membrane receptors, Molecular and functional organization of sub-cellular organelles, Peroxisomal and Lysosomal disorders, ABC families of transporters.

**Chemistry of Carbohydrates:** Definition, classification and importance of carbohydrates; chemistry, properties and functions of monosaccharides, disaccharides and polysaccharides; sugar derivatives and their biological importance; location, composition and functions of Glycosaminoglycans (mucopolysaccharides) and its disorders.

**Chemistry of Amino Acids and Proteins:** Classification and properties of amino acids, peptide bond, biologically important peptides, classification, properties and functions of proteins, structural organization of proteins (with reference to hemoglobin, insulin and collagen).

**Plasma Proteins:** Functions and clinical significance of various fractions, methods of separation and electrophoretic pattern in different disorders, acute phase proteins.

**Chemistry and functions of Nucleic acids:** Concept of nucleoside & nucleotide, Biologically important free nucleotides, synthetic nucleotide analogues.

**Molecular Biology :** Structure and higher organization of DNA, structure and types of RNAs, DNA replication, Transcription, post – transcriptional processing, genetic code, Translation, Post translational modifications; inhibitors of protein biosynthesis, Molecular mechanism of gene expression & its regulation, Mutations, mutagens. Rb protein, p53, Cell cycle, DNA damage and its repair mechanisms, apoptosis.

**Chemistry of Lipids:** Classification of lipids, Definition, distribution, classification, properties and function of fatty acids, triglycerides, phospholipids, sterols & others compound lipids, Structure, properties and functions of cholesterol, Eicosanoids, Lipoproteins.

**Enzymology:** Classification, properties and mechanism of enzyme action, co-enzymes, Specificity, regulation (repression & induction) and inhibition of enzyme action; factors affecting enzyme activity,  $K_m$  value and its significance (derivation not required and no details of enzyme kinetics). Isoenzymes – definition and separation. Clinical importance (diagnostic, therapeutic and analytical) of enzymes and isoenzymes.

**Bioenergetics – Electron transport chain:** General concept of oxidation and reduction. Role of enzymes and coenzymes, structure of mitochondrion and organization of electron transport chain, oxidative phosphorylation, inhibitors and uncouplers. High energy compounds. Concept of substrate level phosphorylation.

**Chemistry and Metabolism of Haemoglobin:** Structure and functions of Porphyrin and Haemoglobin, Biosynthesis, catabolism and regulation of heme. Fate of bilirubin, Types of jaundice, porphyrias (in brief), haemoglobinopathies, derivatives of haemoglobin.

**Vitamins:** classification, sources, chemistry (in brief), active forms, Biochemical role, deficiency manifestations, recommended daily allowance ( RDA ) of fat soluble and water soluble vitamins. Hypervitaminosis.

**Nutrition:** Balance diet, calorific value of foodstuffs, nitrogen balance, BMR, SDA, RQ, Nutritional importance of carbohydrates, proteins & lipids; Dietary fibre, Glycemic index, Assessment of nutritional value of proteins, Protein - energy malnutrition – Kwashiorkar and Marasmus, Obesity.

**Carbohydrate Metabolism:** Biochemical aspects of digestion and absorption of carbohydrates. Glycolysis & its regulation; Rapaport Leubering cycle, TCA Cycle & its regulation, Cori's cycle, Gluconeogenesis, Hexose Monophosphate Shunt ( HMP ) pathway and its significance; Uronic acid pathway; Biosynthesis & catabolism of Glycogen, glycogen storage diseases; Metabolism of Galactose and Galactosemia, Metabolism of Fructose, Sorbitol pathway ; Regulation of blood glucose level, Hormonal control, GTT, Glycosuria, Inborn errors of carbohydrate metabolism. Biochemistry of diabetes mellitus.

**Amino acids and Protein Metabolism:** Biochemical aspects of digestion and absorption of proteins. Fate of amino acids in the body - Transamination, Oxidative & non-oxidative deamination, Transamidation, decarboxylation. Ammonia toxicity & Fate of ammonia – urea cycle, Disorders of urea cycle.

Metabolism of individual amino acids – Glycine, Phenylalanine, Tyrosine, Tryptophan, sulphur containing amino acids, branched chain amino acids and their inborn errors, Nitric oxide (NO).

**Lipid Metabolism:** Biochemical aspects of digestion and absorption of lipids. Oxidation of fatty acids its types and regulation, Biosynthesis of fatty acids and its regulation, Biosynthesis and transport of cholesterol and its regulation, catabolism of cholesterol, Metabolism of adipose tissue – lipogenesis & lipolysis, fatty liver & lipotropic factors, Ketogenesis, ketolysis & ketosis; Metabolism of plasma lipoproteins, Disorders of plasma lipoproteins, Alcohol metabolism, inborn errors of lipid metabolism, Atherosclerosis.

**Integration of metabolisms:** Metabolic interrelationship of carbohydrates, lipids and protein metabolism. Metabolism in starvation and fed condition.

**Metabolism of Purines & pyrimidines:** Biosynthesis of purines – sources of carbon & nitrogen of purine ring, conversion of IMP to GMP & AMP and regulatory steps only. Biosynthesis of pyrimidines & its regulation, salvage pathway, catabolism of purines & pyrimidines; Gout, Lesch – Nyhan syndrome, Orotic Aciduria.

**Mineral Metabolism:** sources, absorption, transport, functions, dietary requirement, excretion, deficiency manifestations (as applicable) of calcium, phosphorus , magnesium , Iron , Iodine , copper , sodium, potassium, chloride & Trace elements – manganese, selenium , zinc & fluoride.

**Hormones:** General characteristics, classification, mechanism of hormone action, second messengers and their role.

**Water and electrolyte balance, Body fluids:** Distribution & composition. Water & electrolyte balance /imbalance in health & disease, Donnan membrane equilibrium.

**Acid - Base balance & pH:** Acids & bases, Henderson – Hasselbalch equation, buffers, buffers of body fluids, Acid – base balance & pH homeostasis, Metabolic acidosis & alkalosis; Respiratory acidosis & alkalosis.

**Organ Function Tests:** Liver function tests; Kidney function tests and thyroid function tests; Cardiac profile, Pancreatic and Gastric functions tests.

**Biotransformation (detoxification mechanism):** Phase I reactions – oxidation, reduction & hydrolysis; Phase II reactions – conjugation.

**Genetic Engineering:** recombinant DNA technology, restriction endonuclease, vectors, chimeric molecule, applications of recombinant DNA technology in relation to medicine.

**Molecular Biology Techniques: *Principle and applications*** of DNA hybridization techniques, southern blot, northern blot, western blot, restriction length polymorphism (RFLP), DNA finger printing technique, polymerase chain reaction (PCR), Hybridoma technology.

**Molecular concept of body defence and their applications:** Immunoglobulins: structure & functions.

**Free Radicals:** Definition, generation, mode of action, damage done to biomolecules, Lipid peroxidation, free radical scavenging systems – enzymatic & non - enzymatic antioxidants , Role of free radicals in disease process.

**Radioisotopes:** Radiations, units of radioactivity, therapeutic and diagnostic uses of radioisotopes. Biological effects of radiations, Radiation hazards.

**Biochemistry of cancer:** Carcinogens, oncogenes, onco-suppressor genes, antimutagens, mechanism of carcinogenesis, tumor markers, Anti cancer drugs.

**Environmental Biochemistry:** Chemical hazards; air, water and noise pollution, Heavy metal poisons.

**Biochemistry of AIDS:** Transmission, Natural course of the disease, HIV genes and gene products, Immunology of AIDS, laboratory analysis anti – HIV drugs.

**Advanced Techniques (LCD Topics): *Principle and applications of*** - Electrophoresis, Chromatography, Colorimeter, Spectrophotometer, Flame photometer, pH meter and advanced techniques (RIA etc).

## **Curriculum for Practical Training in Biochemistry 1<sup>st</sup> M.B.B.S**

Biochemistry practical's are designed to enable the students to understand the basic aspects of normal and abnormal conditions and interpretation of the investigations so as to help in clinical screening and diagnosis. Practical will be followed by the discussion on the theoretical concepts of disease, different techniques employed and instrumentation.

### **SYLLABUS FOR PRACTICAL**

- 1) Tests for monosaccharides.
- 2) Tests for disaccharides.
- 3) Tests for polysaccharides.
- 4) Colour reactions of Proteins.
- 5) Precipitation reactions of proteins.
- 6) Estimation of plasma glucose.
- 7) Estimation of plasma urea.
- 8) Estimation of serum uric acid.
- 9) Estimation of serum creatinine.
- 10) Estimation of urine creatinine.
- 11) Estimation of serum total protein & albumin and calculation of A/G ratio.
- 12) Estimation of serum cholesterol.
- 13) Estimation of Serum Triglycerides.
- 14) Estimation of serum inorganic phosphorus.
- 15) Determination of serum amylase activity.
- 16) Normal urine: Physical characteristics and composition - organic & inorganic constituents.
- 17) Urine report: Physical characteristics and abnormal constituents.
- 18) Composition of C.S.F.

### **Lecture cum Demonstration (LCD) Topics.**

- 1) Glucose tolerance test
- 2) pH meter.
- 3) Beer – Lambert's Law. Colorimeter, Spectrophotometer, Semi-automatic and automatic analyzer.
- 4) Electrophoresis.
- 5) Chromatography.
- 6) Cardiac profile
- 7) Diabetic profile
- 8) Lipid profile
- 9) Liver profile
- 10) Renal profile
- 11) Specialized techniques
- 12) Discussion of reference biological interval of indices and their interpretation.
- 13) Interpretative clinical chemistry with case report.
- 14) Biological waste management and blood collecting vacuttes.

### **Theory Examination :**

There shall be **two papers** of three hours duration each. The papers shall be of **50 marks** each. All the questions shall be compulsory with internal choice. While setting the paper the care shall be taken to give coverage to the entire syllabus.

#### **Paper-wise distribution of Theory topics.**

**(Structural formulae are not essential).**

##### **Paper: I (50 Marks)**

1. Molecular and functional organization of cell and cellular organelles.
2. Chemistry and metabolism of Carbohydrates and related disorders.
3. Chemistry and metabolism of lipids and related disorders.
4. Enzymology.
5. Bioenergetics – biological oxidation, Electron transport chain.
6. Chemistry and metabolism of Hemoglobin.
7. Water and electrolyte balance and imbalance.
8. Body fluids, pH, Buffers, Acid base balance and imbalance
9. Cancer Biochemistry- Biochemical basis of cancer and carcinogenesis.
10. Organ functions tests.
11. Molecular concept of body defense and their role, Free radicals and Antioxidants
12. Environmental biochemistry, Diagnostic techniques.

##### **Paper: II (50 Marks)**

1. Chemistry and metabolism of protein and related disorders including plasma proteins.
2. Chemistry and metabolism of purines & pyrimidines and related disorders.
3. Chemistry and functions of Nucleic acids, Molecular Biology.
4. Genetic engineering and its applications in medicine, including molecular biology techniques.
5. Integration of metabolisms, Starvation and fed condition metabolism.
6. Mineral metabolism.
7. Vitamins.
8. Nutrition
9. Mechanism of hormone action.
10. Biotransformation (Detoxication) mechanisms.
11. Advanced techniques and LCD topics.
12. Radioisotopes.

## **Practical and Viva-voce Examination**

1. There shall be at least four examiners up to 100 candidates appearing in examination, thereafter for every incremental increase of 25 candidates appearing in examination one examiner will add up i.e. for 150 candidates appearing in examination; number of examiner shall be six. Out of whom not less than 50% shall be external examiners. Of the total examiners, the senior most internal examiner will act as Chairman/Convener. The Chairman will make distribution of Practical & viva – voce assessment, so that all examiners will examine each candidate.

Practical examination in Biochemistry shall be of 2 hours duration: **40 Marks**

**Q1.** One quantitative experiment from **group A** **20 Marks**

**Q2.** One qualitative experiment from **group B** **14 Marks**

**Q3.** Interpretation of biochemical findings of patient / **06 Marks**  
Selected tests /Use of instrument or appliance /  
Identification of slide under microscope/Interpretative case report

### **Group A:**

Quantitative estimations using plasma or serum (as applicable) of Glucose, Urea, Creatinine, Total proteins and A/G ratio, Uric acid, Inorganic phosphorus, Cholesterol, Triglycerides. Determination of activity of serum amylase and estimation of Creatinine in urine.

### **Group B:**

Qualitative tests for monosaccharides/disaccharides/polysaccharides , Colour reactions of proteins, Precipitation reactions of proteins, Composition of CSF, Organic/inorganic constituents of normal urine, urine report (abnormal constituents).

2. Viva-voce examination in Biochemistry shall be of **20 Marks** and shall be taken by pair of examiners (one external and one internal) for each candidate.

**Internal Assessment:**

Scheme of internal evaluation marks in Biochemistry is as follows –

	<b>Theory</b>	<b>Practical</b>
	Marks	Marks
Terminal examination	<b>5.0</b>	<b>5.0</b>
Preliminary examination	<b>7.5</b>	<b>7.5</b>
Day to day evaluation (Periodic test/Viva-voce, seminar/case presentation/Practical Journal etc)	<b>7.5</b>	<b>7.5</b>
<b>Total</b>	<b>20.0</b>	<b>20.0</b>

- 75% of attendance in a subject for appearing in examination is compulsory (in Didactic and non-didactic teaching each)
- Students must secure at least 35% marks of the total marks fixed for internal assessment in a particular subject, in order to be eligible to appear in University examination of the subject.

- **Marks fractionation:**

- **Theory :**

Paper I. **50 Marks**

Paper II **50 Marks**

Theory – viva **20 Marks**

Total **120 Marks**

- **Practical :** Total **40 Marks**

- **Internal assessment**

Theory **20 Marks**

Practical **20 Marks**

Total **40 Marks**

**Total Marks: Theory + Practical + internal assessment = 200.**