

## **Biochemistry**

### **Distribution of marks:**

Total marks: 100 (Theory 50marks + Practical 50 marks)

### **Theory:**

Theory exam (35); Internal Assessment (5); Theory viva (10) = 50 marks

### **Practical:**

Final Practical (40) + Record (5) + Internal practical (5) =50 marks

### **Internal assessments:**

3 internal assessments will be conducted every year.

The continuing assessment examinations may be held frequently at least 3 times in a particular year and the average marks of these examinations should be considered. 10% of the total marks in each subject for both theory, practical and clinical examination separately should be set aside for the internal assessment examinations.

**The referred and detained students are also required to appear for a minimum of one internal assessment examination in theory and practical / clinical in the subjects concerned.** New assessment marks are to be taken for the declaration of the results.

If the candidate is absent for any of the examinations, the marks in that shall be treated as zero.

Internal assessment examination should include MCQ's.

**Part completion tests & weekly tests:** Going on regularly

### **Eligibility to write university Exam:**

Attendance percentage in theory and practicals should be more than 75% individually.

## BIOCHEMISTRY AND NUTRITION

### AIM:

The major aim is to provide a sound but crisp knowledge on the biochemical basis of the life processes relevant to the human system and to dental / medical practice. The contents should be organized to build on the already existing information available to the students in the pre-university stage and reorienting.

The chemistry portion should strive towards providing information on the functional groups, hydrophobic and hydrophilic moieties and weak valence forces that organize macromolecules. Details on structure need not be emphasized.

Discussion on metabolic processes should put emphasis on the overall change, interdependence and molecular turnover. While details of the steps may be given, the student should not be expected to memorise them. An introduction to biochemical genetics and molecular biology is a must but details should be avoided. The exposure to anti vitamins, anti metabolites and enzyme inhibitor at this stage, will provide a basis for the future study of medical subjects. An overview of metabolic regulation is to be taught by covering hormonal action, second messengers and regulation of enzyme activities. Medical aspects of biochemistry should avoid describing innumerable functional tests, most of which are not in vogue cataloguing genetic disorders under each head of metabolism is unnecessary. A few examples which correlate genotype change to functional changes should be adequate.

At the end of the course the student would be able to acquire a useful core of information, which can be retained for a long time . Typical acid tests can be used to determine what is to be taught or what is to be learnt. A few examples are given below.

1. Need not know the structure of cholesterol. Should know why it cannot be carried free in plasma.
2. Mutarotation should not be taught. Student should know why amylase will not hydrolyse cellulose.
3. Need not know the details of alpha - helix and beta – pleats in proteins.
4. Need not know mechanism of oxidative phosphorylation. Should know more than 90% of ATP is formed by this process.
5. Need not know details of the conversion of pepsinogen to pepsin. Should know hydrochloric acid cannot break a peptide bond at room temperature.
6. Need not remember the steps of glycogenesis. Should know that glycogen can also be synthesised from non carbohydrate sources.

7. Need not know about urea or creatinine clearance tests. Should know the basis of increase of urea and creatinine in blood in renal insufficiency.
8. Need not know the structure of insulin. Should know why insulin level in circulation is normal in most cases of maturity onset diabetes.
9. Need not know the structural details of ATP.
10. Need not know the mechanism of action of prolylhydroxylase. Should know why the gum bleeds in scurvy.
11. Need not know the structure of Vitamin K. Should know the basis of internal bleeding arising due to its deficiency.
12. Need not remember the structure of HMGCoA. Should know why it does not lead to increased cholesterol synthesis in starvation.

## **COURSE CONTENT:**

### **1. CHEMISTRY OF BIO-ORGANIC MOLECULES**

- Carbohydrates: Definition , biological importance and classification. Monosaccharides –Isomerism , Anomerism. Sugar derivatives, Disaccharides, Polysaccharides. Structures of starch and glycogen.
- Lipids : Definition , biological importance and classification. Fats and fatty acids. Introduction to compound lipids. Hydrophobic and hydrophilic groups, cholesterol, Bile salts, Micelle, Bimolecular leaflet.
- Proteins: Biological importance; aminoacids : classification. Introduction to peptides. Proteins: simple and conjugated ; globular and fibrous. Charge properties, Buffer action. Introduction to protein conformation : Denaturation.
- Nucleic acids : Building units Nucleotides. Outline of structure of DNA and RNA. High energy compound ATP, Phosphorylamidines, Thiolesters, Enol phosphates.

### **2. MACRONUTRIENTS AND DIGESTION**

- Energy needs : Basal metabolic rate. Dietary carbohydrates, fibres. Dietary lipids, essential fatty acids. Nitrogen balance. Essential amino acids. Protein quality and requirement ( methods for evaluation of protein quality to be excluded). Protein calorie malnutrition. Balanced diet.

- Enzymatic hydrolysis of dietary carbohydrates. Mechanism of uptake of monosaccharides. Digestion and absorption of triacylglycerols. Enzymatic hydrolysis of dietary proteins and uptake of amino acids.

### **3. MICRONUTRIENTS**

- Vitamins: Definition, classification, daily requirement, sources and deficiency symptoms. Brief account of water soluble vitamin D and its role in calcium metabolism. Vitamin E. Vitamin K and gamma carboxylation, Introduction to antivitamins and hypervitaminosis.
- Minerals: Classification, daily requirement calcium and phosphate: sources, uptake, excretion, function.
- Serum calcium regulation.
- Iron: sources, uptake and transport. Heme and nonheme iron functions ; deficiency.
- Iodine : Brief introduction to thyroxine synthesis. General; functions of thyroxine.
- Fluoride: function, deficiency and excess.
- Indications of role of other minerals.

### **4.ENERGY METABOLISM OF OVERVIEW**

Outline of glycolysis, pyruvate oxidation and citric acid cycle. Beta oxidation of fatty acids. Electron transport chain and oxidative phosphorylation. Ketone body formation and utilization. Introduction to glycogenesis, glycogenolysis, fattyacid synthesis, lipogenesis and lipolysis. Gluconeogenesis .

Lactate metabolism.

Protein utilization for energy.

Glucogenic and ketogenic amino acids.

Integration of metabolism.

### **5.SPECIAL ASPECTS OF METABOLISM**

Importance of pentose phosphate pathway. Formation of glucuronic acid. Outline of cholesterol synthesis and breakdown . Ammonia metabolism . Urea formation.Phosphocreatine formation. Transmethylation. Amines . Introduction to other functions of amino acids including one carbon transfer . Detoxication ; Typical reactions. Examples of toxic compounds. Oxygen toxicity.

### **6. BIOCHEMICAL GENETICS AND PROTEIN SYNTHESIS**

Introduction to nucleotides: formation and degradation DNA as genetic material.

Introduction to replication and transcription. Forms and functions of RNA. Genetic code and mutation . Outline of translation process. Antimetabolites and antibiotics interfering in replication, transcription and translation. Introduction to cancer, virus and oncogenes.

## **7. ENZYME AND METABOLIC REGULATION**

- Enzymes : Definition, classification. specificity and active site. Cofactors. Effect of pH, temperature and substrate concentration, introduction to enzyme inhibitors, proenzymes and isoenzymes. Introduction to allosteric regulation, covalent modification and regulation by induction / repression.
- Overview of hormones. Introduction to second messengers, cyclic AMP, calcium ion, inositol triphosphate. Mechanism of action of steroid hormones, Epinephrine, glucagons and insulin in brief. Acid base regulation . Electrolyte balance.

## **8. STRUCTURAL COMPONENTS AND BLOOD PROTEINS**

- Connective tissue: Collagen and elastin. Glycosaminoglycans. Bone structure. Structure of membranes. Membrane associated processes in brief. Exocytosis and endocytosis. Introduction to cytoskeleton . Myofibrill and muscle contraction in brief.
- Haemoglobin: Functions, Introduction to heme synthesis and degradation. Plasma proteins:- classification and separation, Function of albumin . A brief account of immunoglobulins . Plasma lipoproteins: Formation, function and turnover.

## **9. MEDICAL BIOCHEMISTRY**

- a) Regulation of blood glucose. Diabetes mellitus and related disorders. Evaluation of glycemc status.
- b) Hyperthyroidism and hypothyroidism Biochemical evaluation.
- c) Hyperlipoproteinemias and atherosclerosis, Approaches to treatment.
- d) Jaundice: Classification and evaluation, Liver function tests, Plasma protein pattern, serum enzymes levels.
- e) Brief introduction to kidney function tests and gastric function tests.
- f) Acid base imbalance, Electrolyte imbalance evaluation, Gout.
- g) Examples of genetic disorders including lysosomal storage disorders, glycogen storage disorders, glucose 6- phosphate dehydrogenase deficiency., hemoglobinopathies, inborn errors of amino acid metabolism and muscular dystrophy ( one or two examples with biochemical basis will be adequate).
- h) Serum enzymes in diagnosis.

PRACTICAL : Contact hours 50

1. Qualitative analysis of carbohydrates	4
2. Color reaction of protein and amino acids	4
3. Identification of nonprotein nitrogen substances	4
4. Normal constituents of urine	4
5. Abnormal constituents of urine	4
6. Analysis of saliva including amylase	2
7. Analysis of milk; quantitative estimations	2
8. Titratable acidity and ammonia in urine	2
9. Free and total acidity in gastric juice	2
10. Blood glucose estimation	2
11. Serum total protein estimation	2
12. Urine creatinine estimation demonstration	2
13. Paper electrophoresis charts / clinical data evaluation	2
14. Glucose tolerance test profiles	2
15. Serum lipid profiles	1
16. Profiles of hypothyroidism and hyperthyroidism	1
17. Profiles of hyper and hypoparathyroidism	1
18. Profiles of liver function	1
19. Urea, uric acid creatinine profile in kidney disorders	1
20. Blood gas profile in acidosis / alkalosis	1

RECOMMENDED BOOKS :

1. Concise text book of Biochemistry (3<sup>rd</sup> edition) 2001, T.N. Pattabiraman
2. Nutritional Biochemistry 1995, S. Ramakrishna and S. V. Rao
3. lecture notes in Biochemistry 1984, J. K. Kandlish

REFERENCE BOOKS:

1. Text book of Biochemistry with clinical correlation 1997, T.N. Devlin
2. Harper's Biochemistry, 1996., R. K. Murray et. al
3. Basic and applied Dental Biochemistry , 1997, R. A. D. Williams & J.C Elliot