

## مفردات منهج الكيمياء الحياتية / الصف الثاني

اسم المادة	المرحلة	عدد الساعات النظري	عدد الساعات العملي	مناقشة	المجموع	الوحدات
الكيمياء الحياتية	الثانية	90	60	30	180	8

### • Vitamins (7 hrs):

1. Definition
  2. Classification : water soluble includes: Vitamin B Complex, C, and lipid soluble vitamins (A, D,E,K)
- For each individual vitamin, the following points should be considered:
- Type , Sources , Daily requirement , Biochemical functions
  - Deficiency, Toxicity ( for lipid soluble vitamins )

### • Diagnostic Enzymology (4 hrs):

1. Definition
2. Factors affecting plasma enzyme activity
3. The steady state of plasma enzyme activity
4. Enzymes of useful clinical significance:  
A: Amylase, B: Alkaline phosphatase, C: Acid Phosphatase  
D: Aminotransferases, E: Lactate dehydrogenase isoenzymes  
G: Gamma – glutamyl transferase
5. Enzyme diagnosis of acute myocardial infarction
6. Enzyme diagnosis of liver disease

### ❖ Introduction to intermediary metabolism ( 2hrs)

- Catabolism and Anabolism, - Steady state and dynamic state

### ❖ Carbohydrate Metabolism (17 hrs)

- Catabolism of carbohydrates
  - Digestion of carbohydrates
  - Transport of blood glucose

- **Glycolysis ; Definition ; aerobic and anaerobic , localization and metabolic pathway**
- **Physiological importance of anaerobic glycolysis i.e. in muscle contraction and RBC**
- **Importance of glycolysis other than ATP formation.**
- **Glucose 6 phosphate has 5 different metabolic routes**
- **Fates of pyruvate , formation of acetyl CoA and lactate**
- **Control of glycolysis ; 3 irreversible enzyme reactions : HK PFK PK**
- **Disorder of glycolysis; lactic acidosis and hereditary enzymopathy**
- **Citric Acid cycle**
  - **Definition, function and formation of acetyl coA**
  - **Component of the cycle and localization**
  - **Pasteur effect , Amphibiotic nature of the cycle**
- **Hexose monophosphate shunt**
  - **Definition ; oxidative and non-oxidative pathway**
  - **Importance and localization , Supply of NADPH and pentose**
  - **Discuss the consequences of thiamine deficiency on the non-oxidative branch**
  - **Importance of NADPH in RBC metabolism and role of reduced glutathione**
  - **G6PD deficiency ; favism**
- **Fructose and Galactose Metabolism**
  - **Conversion to glucose , Fructosuria and fructose intolerance**
  - **Galactosemia and galactosuria**
- **Diasaccharides Metabolism**
  - **lactose , maltose and sucrose ,Lactase deficiency**
- **Glycogen Metabolism**
  - **Glycogenolysis and glycogenesis .Importance and localization**
  - **Control of glycogen metabolism; allosteric and hormonal**
  - **Glycogen storage disease**
- **Gluconeogenesis**
  - **Definition , importance and localization**
  - **Metabolic pathways involved in gluconeogenesis**
  - **Enzymes specific for gluconeogenesis**
  - **Control mechanism**
- **Sources of blood glucose**

- Regulation of blood glucose ; hepatic and extrahepatic
- Hormonal effects on blood glucose levels ; insulin and glucagon
- Disorders of blood glucose : Diabetes Mellitus
- DM types and role of glycation : Glycosylated Hb and proteins
- Laboratory tests used to investigate blood glucose disorders
- Fasting and post prandial blood sugar, glucose tolerance test (GTT)
- Glycemic control, Hb A1c

- **Biological Oxidation (2 hrs)**

- Electron Transport chain
- Mitochondria
- Organization of electron transport chain
  - 1- Complex I            NADH Dehydrogenase
  - 2- Complex II         Succinate Dehydrogenase
  - 3- Complex III        Cytochrome bc Complex
  - 4- Complex IV        Cytochrome Oxidase
- Oxidative phosphorylation
- Chemiosmotic theory
- Energy Yield from Electron transport chain
- Respiratory Chain inhibition
  1. *Inhibitory of electron transport system*
  2. *Inhibitory of oxidative phosphorylation*
  3. *Uncoupler of oxidative phosphorylation*
- OXPHOS Diseases

- **Cell Membrane (2 hrs)**

Definition

Structure of cell membrane

- 1 – Lipid bilayer
- 2 – Proteins
- 3- Carbohydrate (Glycocalyx)

Lipid In Plasma Membrane

Phospholipid , Cholesterol .

Protein In Plasma Membrane; Integral protein ,Peripheral protein

*Glycocalyx*

Membrane Functions

Receptor Functions

Transport function

- 1- simple diffusion ,
  - 2- facilitated diffusion
  - 3- gated channel in plasma membrane,
  - 4- active transport pump
- Cystic Fibrosis Transmembrane conductance Regulator

- **Nutrition and Obesity (5hrs)**

Definition of nutrition

Function of Diet

Dietary Reference Intakes

- Estimated Average Requirement (EAR)
- Recommended Dietary Allowance (RDA)
- Adequate Intake (AI)
- Tolerable Upper Intake Level:- (UL)

Basal ( resting ) metabolic rate (BMR, RMR)

Factors affecting BMR

Dietary Fats:

1. Saturated fat
2. Polyunsaturated fatty acid
  - $\omega$ 6 Fatty Acid
  - $\omega$ 3 Fatty Acid

Fibers

Dietary carbohydrate and blood glucose

Dietary protein & Nitrogen balance

Protein Energy Malnutrition (PEM)

- Marasmus
- Kwashiorkor

Definition of obesity

- Assessment Of Obesity
- Anatomic difference in fat distribution
- Biochemical difference in regional fat depots

Hormones Of Adipose Tissue

Metabolic Changes In Obesity metabolic syndrome

Nutritional support

- Enteral feeding
- Parenteral feeding

- **HAEMOGLOBIN (3 hrs)**

Definition

- 1- Structure of globins including primary, secondary, tertiary, and quaternary structures
- 2- Structure of haem
- 3- Metabolism of Hb
- 4- Porphyrins and their synthesis
- 5- Molecular pathology emphasizing on Hb-S
- 6- Derived Hb
- 7- Porphyrias
- 8- Functional differences between myoglobin and Hb regarding oxygen dissociation curve .

- **Free radicals (2 hrs)**

- Free Radicals

- Generation of Reactive Oxygen Species (ROS)
- Source of Reactive Oxygen Species
- Reaction with Cellular components
- Free radical in Phagocytosis and inflammation
- Defense Against Oxygen Toxicity

- **Nucleotide metabolism (5 hrs)**

- Nucleotide Structure
- Synthesis of Purine Nucleotides
- Synthetic inhibitors
- Degradation Of Purine Nucleotide ; Salvage Pathway
- Hyperuricaemia and Gout
- Pyrimidine Synthesis , Orotic aciduria

- **Acid base disturbance (3 hrs)**

- The types of buffer systems that include.
- -Carbonic acid bicarbonate system.
- -Protein system. And -Hem globulin system.
- -Mono hydrogen and dihydrogen phosphate.
- -Compansetary control by lungs and kidney.

- **Immuno globulin (2 hrs)**

- Immuno globulin used to protect and to defiance the body against any micro organism.
- One can know the classes of Ig, levels, percentage of each, source of excretion.
- Physiological and pathological causes of increase and decease of immune globulin.
- \_ condition of paraproteinemia.

- **Amino Acid Metabolism (6 hrs):**

- Amino acid pool
- Amino acid catabolism including :
  - a. Transamination.
  - b. Deamination
  - c. Catabolism of carbon skeletons
- Ammonia metabolism:
  - a. Sources.

- b. Transport
- c. Fate including urea cycle
- Single carbon transfer with emphasis on creatine metabolism
- Synthesis of non-essential amino acids
- Conversion of amino acid into specialized products
- Inborn error of metabolism

### • Protein metabolism (6 hrs)

- -Protein turnover, that is the continuous degradation and re synthesis of all cellular protein all forms of life.
- -to know the process of a-Replication. b-Transcription. c- Translation.
- -Genetic code .
- -To know the steps of protein synthesis which include
- Activation. 2. Initiation. 3. Elongation. 4. Termination. 5. Post modification.
- To know the type of mutations whether they are lethal or not lethal.

### • Renal System (3 hrs) :

- Structure of the nephron.
- Physiologic role of each of part of the nephron.
- Significance and calculation of glomerular filtration rate and estimation of glomerular filtration rate.
- The tests in a urine analysis and understanding the clinical significance of each.
- Diseases of the glomerulus and tubules and laboratory tests used in these disorders.

### • Mineral Metabolism (5 hrs)

- Importance and classification
- The mineral classified into five classes.
- 1. That contain: C,H,N,O and S.
  - 2. Nutritional elements.
  - 3.Trace elements.

- 4. Additional elements.
- 5. Toxic elements.
- From each class and each type of element one can know the normal value, metabolism and clinical significance of that element and interpretation of any abnormality

- **Antioxidants (2 hrs)**

- Reactive nitrogen species
- Mechanism of cellular damage
- Generation of free radicals
- Autocatalytic chain reaction
- Antioxidant defense mechanisms:
- Antioxidant molecules.
- Antioxidant metalloenzyme system

- **Hormones (8 hrs):**

1. Definition
2. Classification
3. Mechanism of hormone action
4. Hormone receptors
5. Intracellular messengers:
  - A: cAMP B: cGMP C: Calcium D: Phosphatidylinositol
  - E: Kinase or Phosphatase cascade
6. Feedback control ( long-loop and short-loop feedback control )
7. Hypothalamic – pituitary – target organ axis
8. Hormone assay
9. Hypothalamic hormones
10. The Anterior pituitary:
  - A: Structure B: Control of secretion
  - C: Anterior pituitary hormones ( GH, PRL, TSH, LH, FSH, ACTH, LPH, and MSH)
  - D: Pro-opiomelanocortin peptide family
  - E: Disorders of secretion
11. The Posterior pituitary:
  - A: Structure B: Control of secretion C: Posterior pituitary hormones ( Oxytocin and ADH)
  - E: Disorders of secretion

**12. The Thyroid gland:**

**A: Structure B: Control of secretion**

**C: Thyroid hormones ( T4 and T3)**

**D: Tests of thyroid function**

**E: Calcitonin F: Disorders of secretion**

**13. The Parathyroid glands:**

**A: Structure B: Control of secretion C: Parathyroid hormone (PTH)**

**E: Disorders of secretion**

**14. The Adrenal cortex:**

**A: Structure , B: Control of secretion , C: Adrenal cortical hormones**

**1. Glucocorticoids 2. Mineralocorticoids, 3. Androgen precursor**

**D: Disorders of secretion**

**E: Congenital adrenal hyperplasia**

**15. The Adrenal Medulla:**

**A: Structure B: Control of secretion**

**C: Adrenal Medullary hormones (Catecholamines):**

**1. Adrenaline 2. Noradrenaline 3. Dopamine**

**D: Metabolism of catecholamines**

**E: Disorders of secretion**

**16. The Gonads:**

**A: Testes: 1. Structure , 2. Control of secretion**

**3. Testosterone and DHT 4: Disorders of secretion**

**B: Ovaries: 1. Structure 2. Control of secretion**

**1. Oestrogens and Progestins**

**2. Disorders of secretion**

**3. PCOS**

**17. The Pancreas:**

**A: structure: B: Pancreatic islets**

**C: Pancreatic hormones ( Insulin, Glucagon, Somatostatin, Pancreatic polypeptide and Serotonin)**

**D: Control of insulin secretion**

**E: Diabetes mellitus**

**• Chemistry of Cancer (2 hrs)**



- Definitions of neoplasm
- Features of cancer cells
- Causative factors including:
  - a. Radiant energy
  - b. Chemical carcinogens including the process of metabolic activation
  - c. Oncogenic viruses
- Types of DNA damage
- Morphological and biochemical changes upon malignant transformation
  - a. Tumor markers including: a. Definition. B. Application. C.Types

- **Xenobiotics (2 hrs)**

- Definition.
- Phase I and Phase II of metabolism
- Features of cytochrome P450
- Types of conjugation reactions
- Damage of cellular macromolecules.

- **Lipid Metabolism (12 hrs):**

- 1- Main classes of plasma lipids
- 2- Circulation and mobilization
- 3- Lipoproteins
  - a- Classification, b. Composition , c. Functions , d. Apoproteins
  - b- Metabolism of Chylomicrons, VLDL, LDL, and HDL
- 4- Fatty acids oxidation
  - a- Activation and transportation across mitochondrial membrane
  - b-  $\beta$ -oxidation pathway , Oxidation of unsaturated fatty acids
  - c- ATP generation
- 5- Fatty acids synthesis
  - a- Transport of acetyl-CoA to cytoplasm
  - b- Formation of malonyl-CoA

- c- Fatty acid synthetase multienzymes complex
- d- Elongation of the chain
- e- Synthesis of unsaturated fatty acids
- 6- Ketone bodies formation and disposition
  - a- Ketogenesis
  - b- Utilization of ketone bodies
  - c- Ketosis and Mechanism of ketosis
- 7- Synthesis of TG
- 8- Synthesis of phospholipids
- 9- Sphingolipids
  - a- Classes, b. Synthesis and degradation , c. sphingolipidosis
- 10- Cholesterol metabolism
  - a- Sources, benefit , Biosynthesis and their stages
- 11-
  - a- Factors affecting serum cholesterol level
  - b- Lipoproteinaemia
    - 1- Hypolipoproteinaemia and their classes
    - 2- Hyperlipoproteinaemia and their classes
  - c- Hypolipidaemic drugs

- **The Muscle (2 hrs):**

1. Structure.
2. Biochemical events during muscle contraction
3. Role of calcium in muscle contraction
4. Plasma enzyme changes in muscle disorders
5. Classification of muscle diseases

- **Metabolic Response To Trauma ( 2 hrs)**

1. Conditions triggering metabolic response
2. Summary of the metabolic response to trauma
3. Factors mediating the metabolic response to trauma
4. Phases of the metabolic response to trauma
5. Hormonal changes in response to trauma
6. Endocrine response
7. Factors modifying the metabolic response to trauma
8. Physiological changes occurring during catabolism

9. Complications of a prolonged catabolic state

10. The anabolic phase

### ❖ Regulation & Integration of Metabolism (3 hrs)

- Introduction – Summary of CHO, Lipid, & Protein
- General regulation of metabolism
- Role of small molecules in metabolism
- Metabolism of specialized tissue & Organ inter-relation
- Regulation of energy metabolism
  - During a meal
  - After a meal
  - During Starvation

### ❖ Liver Functions Tests (3 hrs)

- Illustrate composition of liver lobules
- Estimate the major function of liver
- Demonstrate the metabolism of bilirubin
- Define and demonstrate different type of jaundice
- Explain the enzyme affected by liver diseases