BIOCHEMISTRY
THE COURSE BOOKLET
FOR STUDENT & STAFF
THE ACADEMIC YEAR 2004-2005
PRE-CLINICAL STAGE

BY
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1. **Title of the Course**: Biochemistry  
2. **Level of Students**: Year - I  

**Mission**  
The Department of Biochemistry and Molecular Biology builds and disseminates understanding of the molecular basis of life.

**Vision**  
The Department of Biochemistry and Molecular Biology will increase knowledge, advance our understanding of the basic mechanisms of life, and ultimately improve the human condition and quality of life through:  
- Outstanding educational programs that produce graduates of world-class caliber.  
- Recognized, vigorous research programs that make important discoveries.

**Biochemistry Courses I, II**  
This course describes the molecular basis of cell function and the biochemical basis of structure and functions of the body. Special attention is given to disease states caused by biochemical abnormalities as well as genetic abnormalities. The broad objective of the course is to contribute to the formation of a solid foundation of knowledge for future comprehension of clinical diagnosis and therapy. Laboratories are intended to reinforce basic concepts and to demonstrate the biochemical basis of key metabolic diseases. Clinical case presentations and small problem-based learning groups are used for instruction as well. Biochemistry I is prerequisite to Biochemistry II and Physiology. Biochemistry II is a prerequisite for Physiology, Immunology, Microbiology, and Neuroscience.

Biochemical studies have illuminated many aspects of health and disease, and, conversely, the study of various aspects of health and disease has opened up new areas of biochemistry. This relationship between medicine and biochemistry has important philosophical implications for the former. As long as medical treatment is firmly grounded in a knowledge of biochemistry and other relevant basic sciences, (e.g. physiology, microbiology, nutrition), the practice of medicine will have a rational basis that can be adapted to accommodate new knowledge. As all diseases are manifestations of abnormalities of molecules, chemical reactions, or processes.

There is a wealth of documentation of the uses of biochemistry in prevention, diagnoses, and treatment of disease.

**CONTENTS OF THE COURSE**  
The course of biochemistry consists of the following:  
1. Lecturing programs.  
2. Teacher centered tutorials.
3. Students centered seminars.
4. Visual learning is among the very best methods for teaching students of all ages how to learn, visual learning techniques include graphical ways of working with ideas and presenting information which is achieved through utilizing overhead projector, power point data show and board.
5. Practical program.

**OBJECTIVES OF THE COURSE**

The objectives of biochemistry course are categorized as;

*Ultimate and Terminal*

Ultimate objectives are those to be fulfilled by the end of the course, while the terminal objectives are those connected with various parts of the course.

**Ultimate Objectives (Goals):**

1- Our main goal is to provide a condensed curriculum of strong basic biochemistry and molecular biology and try to confirm ethical principles to prepare them for professional standards and outstanding clinical training.
2- From this point of view we shall try to help the student to accelerate their way of learning through encouraging them to prepare and read each topic.
3- To guide students in acquiring, integrating and applying the basic science principles that underlie biomedical theory and practice.
4- To provide students with knowledge, skills and opportunities to identify, analyze and solve clinically relevant problems and to predict the molecular basis for the causes, effects and methods of treatment of disease.
5- To develop students' awareness of advances in medical science and their ability to evaluate the contribution of research to ever-evolving practice of medicine.
6- To encourage individual and interactive skills needed to engage in effective lifelong learning.
7- At the end of the first semester the students should be able to understand the chemical structure, and function of all biomolecules present in the living organisms.
8-At the end of the second semester the students should be able to understand all metabolic processes occurring in the living cell.
9-As knowledge is not enough students must apply what they learn, through our course we try to correlate biochemical subjects with clinical aspects of different diseases.
10- Moreover, they should understand basic concepts of molecular biology including DNA replication, transcription, protein synthesis, and basic techniques utilized for DNA cloning and diagnosis of genetic disorders

**Terminal Objectives**

At the end of Biochemistry Course the students have to understand the following topics.

- **Physical Chemistry:**
  1- Understand the various definitions of acids and bases.
  2- Explain the role of ionization of various biomolecules in determining the pH of biological fluids.
  3- Know the relationship between pH and ionization constants of different ionisable molecules.
  4- Know the importance of pH buffers in maintaining controlled pH environment in living organisms.

- **Protein & Amino Acids:**
  1- Define amino acids and know their basic structure.
  2- Classify amino acids.
  3- List the derived amino acids & describe their functions.
  4- Enumerate the important functions of amino acids.
  5- Define peptides and protein.
  6- Describe the characteristics of a peptide bond.
  7- List the biologically active peptides.
  8- Classify proteins according to their biological functions and physical & chemical properties.
  9- Explain the four levels of organization of protein.
  10- Define denaturation of protein & explain the mechanism of denaturation.
  11- Explain the structure –function relationships of fibrous protein.
  12- Explain the effect of deficiency of alpha -1- anti-trypsin.

- **Carbohydrates**
  1- Describe the functional groups present in sugars.
  2- Identify glyceraldehydes, dihydroxyacetone, ribose, deoxyribose, glucose, galactose, mannose and fructose.
  3- Explain the difference between D and L- glyceraldehydes.
  4- Define the terms epimers, enantiomers and optical isomers giving examples.
  5- Explain how anomeric carbon arise and describe their importance.
6- Describe how glucuronic acid, sorbitol and galactitol are formed.
7- Describe how O – and N- Glycosidic bonds are formed and indicate their importance.
8- Identify lactose, maltose, and sucrose and indicate their importance.
9- Describe the structures of starch, glycogen and cellulose and explain why cellulose cannot be metabolized in human.
10- Describe the digestion of carbohydrates and clinical picture in cases of enzymatic deficiencies.

▪ Nutrition

1- Understand of the role of nutrients in sustaining the normal functions of the body.
2- Know the recommended daily allowance of each nutrient and factors affecting it, as well as the energy expenditure and the basal metabolic rate.
3- Know the requirements and function of different macronutrients.

▪ Vitamins

1- List the general characteristics and functions of vitamins.
2- List the fat soluble vitamins and water soluble vitamins.
3- Know the differences in metabolism of the fat soluble and water soluble vitamins.
4- Describe the role of vitamin A in vision.
5- List the different forms of vitamin A.
6- Know the steps of activation of vitamin D
7- Understand the role of vitamin D in calcium metabolism.
8- Understand the role of vitamin E as an anti-oxidant.
9- List the forms and sources of vitamin K.
10-Understand the mechanism of activation of the clotting factors by vitamin K.
11- Know the role of vitamin C in collagen formation and as an antioxidant.
12- Know the structure and different coenzymes derived from vitamin B.
13- Distinguish between clinical pictures of vitamin deficiencies.

▪ Enzymes

1- Define enzyme.
2- Differentiate enzyme (biocatalysts) from the chemical catalysts.
3- Explain the properties of enzymes.
4- List the coenzymes and describe their role in enzyme action.
5- Classify the enzymes and mention the function of each class with examples.
6- Describe the mechanism of action of enzymes.
7- List the features of the active site of the enzyme.
8- Describe the order of chemical reaction.
9- List the various factors affecting enzyme activity.
10- Describe the kinetic features of enzyme inhibitors.
11- Compare between competitive and noncompetitive enzyme inhibitors.
12- Describe the mechanism for regulation of enzyme activity.
13- List the enzymes in used in clinical diagnosis.

**Cell**

- recognize the difference between euokaryotic and prokaryotic cells
- Identify and discuss the structure and functions of the organelles shared between euokaryotic and prokaryotic cells like cytosol, cytoplasmic membrane and DNA molecules.
- identify and discuss the structure and functions of the organelles specific for euokaryotes like mitochondria, nucleus, endoplasmic reticulum, lysosomes, peroxisomes, golgi apparatus, and cytoskeleton

**Minerals**

1- List the major inorganic component of the body.
2- List the functions of calcium, phosphorous, magnesium, sodium, potassium and iron.
3- Describe the regulation of calcium phosphorous, magnesium, sodium, potassium and iron.
4- Define trace elements.
5- List the function of copper, zinc, selenium, fluoride, and iodide.
6- Distinguish the clinical picture of deficiency of different minerals.

**Lipid**

1- Define lipids as a class of biomolecules.
2- List the major classes of lipids found in the human body describe their functions and identify them from structural formulae.
3- Know the structure, types and chemical properties of triacylglycerols.
4- Explain why phospoacylglycerols can be considered the basic building blocks of biological membranes.
5- Identify sphingolipids from their structural formulae and their importance in the nervous system.
6- Identify arachidonic acid, prostaglandins, thromboxanes and Leukotrienes.
7- Identify cholesterol from its structural formula and explain its importance in steroid metabolism.
**Bioenergetics and Oxidative Phosphorylation**

1. Know the role of bioenergetics in the transfer and utilization of energy in biologic systems.
2. It makes use of a few basic ideas from the field of thermodynamics, particularly the concept of free energy.
3. Describe the changes in free energy ($\Delta G$) provide a measure of the energetic feasibility of a chemical reaction and can therefore allow prediction of whether a reaction will take place.
4. Demonstrate the role of the free energy concept in understanding the unique role adenosine triphosphate (ATP) plays in transferring energy from energy-yielding catabolic processes to energy-requiring reactions.
5. Describe the role of oxidative phosphorylation as the major source of ATP and discussing the effect of specific inhibitors and uncouplers.

**Globular hemoproteins**

- Know the 1ry, 2ry, and 3ry structure of myoglobin
- recognize the function and oxygen dissociation curve of the myoglobin
- know the structure and different types of hemoglobin
- discuss the function and oxygen disassociation curve of HB
- recognize the allosteric effectors of HB
- classify different hemoglobinopathies due to genetic mutation or defect in number like abnormal types of HB as S,M. C and Thalassemias

**Basic Concept of Metabolism**

1. Identify the general metabolic Map.
2. Compare between catabolic and anabolic pathways.
3. Outline the basic mechanisms for regulation of metabolism.
4. Describe transduction by intracellular receptors.
5. Describe transduction by cell-surface receptors.
6. Distinguish between different intracellular messenger systems.

**Glycolysis**

1. Define glycolysis.
2. Outline the importance of glycolytic pathway to provide energy (in the form of ATP) and intermediates for other metabolic pathways.
3. List the steps of aerobic and anaerobic glycolysis.
4. Outline the mechanism of regulation of the key enzymes.
5. Discuss the effect of deficiency of pyruvate kinase.
Gluconeogenesis

1- Define gluconeogenesis.
2- Outline the importance of glucose as an energy source in some tissues, such as the brain, red blood cells, kidney medulla, lens and cornea of the eye, testes, and exercising muscle.
3- Distinguish between the role of liver glycogen and gluconeogenesis in maintaining the level of blood glucose level.
4- List the steps of gluconeogenesis.
5- Name the organ in which the pathway occur.
6- Discuss the mechanism of regulation of the key enzymes.

Citric Acid Cycle

1- Understanding the importance of Kreb's cycle.
2- Name the sources of acetyl CoA.
3- List the steps of the cycle.
4- Discuss the regulation of the cycle.
5- Hexose Monophosphate Pathway
6- Understand the importance of the pathway.
7- List the steps and the importance of each stage.
8- Discuss the regulation of the pathway.
9- Discuss the importance NADPH.
10- Describe the clinical picture of G6PDD.

Metabolism of Monosaccharides and Disaccharides

1- List the importance of fructose and galactose.
2- List the steps of metabolism of different monosaccharides.
3- Understand the role of sorbitol in the complication of DM.

Glycogen Metabolism

1- Understand the role of glycogen in maintaining the level of blood glucose.
2- List the steps of glycogen synthesis and degradation.
3- Describe the regulation of glycogen metabolism.
4- Understand the clinical picture of glycogen storage disease.

Glycosaminoglycans and Glycoprotein

1- List the different types of GAG.
2- Discuss the function of each type each type of GAG.
3- Discuss the clinical picture of mucopolysaccharidosis.
4- Name examples of glycoprotein.
5- Discuss the importance of glycoprotein.
Nitrogen Metabolism
1- Memorize that amino acids contain nitrogen in addition to the carbon, hydrogen, and oxygen atoms also found in carbohydrates and fats.
2- Recall that nitrogen cannot be stored, and amino acids in excess of the biosynthetic needs of the cell are immediately degraded.
3- Recognizing that the first phase of catabolism involves the removal of the a-amino groups by transamination and oxidative domination, forming ammonia and the corresponding α-ketoacids.
4- Identify the fate of ammonia and the urea cycle.
5- Memorize the conversion of carbon skeleton of amino acid to common intermediates of energy producing metabolic pathway, which can be metabolized to CO2 and water, glucose, fatty acids, or ketone bodies.
6- Describe the synthesis of nonessential amino acids.
7- Discuss the clinical cases related to defect in amino acid metabolism.
8- Discuss the special compound synthesized from amino acids

Metabolism of Lipids

Digestion and absorption of Dietary lipids:
- Memorize the different phases of lipid digestion
- Identify the enzymes required for these phases
- Distinguish the role of bile acids and salts in lipid digestion
- Describe the absorption of lipid from the intestine to the circulation
- States the disease due to congenital disorders in enzymes of digestion and malabsorption due to abnormal bile production

Fatty Acid Metabolism
- state the steps of fatty acid de novo synthesis
- Describe the rate limiting step of synthesis
- Discuss the structure and the site of enzymes required for pathway
- Explain the short and long term regulation of the pathway
- Recognize the site and requirements of FA elongation and desaturation
- Describe the transport of FA from the cytoplasm for oxidation through carnitine shuttle system
- List the steps of beta oxidation of FA
- Discuss the regulation of the pathway
- Identify the end product of oxidation of odd number FA
- Recognize the other types of FA oxidation (alpha, omega, and oxidation of unsaturated FA)
- Recall the peroxisomal oxidation of FA
- Describe the disorders in FA catabolism due to genetic disorders
**Metabolism of Triacyllycerols:**
- Identify the site, end product, and precursor of TAG metabolism
- Discuss the steps of TAG synthesis and degradation
- Explain the hormonal regulation of lipid metabolism in adipose tissue.

**Phospholipid metabolism:**
- Recognize the synthesis of glycerophospholipids and sphingophospholipids.
- Discuss the catabolism and list the end product of their catabolism
- Identify the enzymes required for catabolism
- Describe the congenital disorders in phospholipids metabolism.

**Cholesterol metabolism:**
- Identify the precursor, site of cholesterol synthesis
- Recognize the normal serum level of cholesterol and tissues of storage
- List the steps and enzymes required for synthesis
- State the importance of cholesterol in synthesis of bile, steroid hormones, vitamin D, and structural role
- Describe the regulation of cholesterol level in tissue and blood, and the role of different lipoproteins in their transport
- Recognize the clinical effects of hypercholesterolemia.
- List the risk factors and prevention of developing atherosclerosis and coronary heart disease.

**Plasma Lipoprotein:**
- Define different types, function, and the structure of lipoproteins
- Describe the source, fate, and changes occurring in blood for each of the lipoproteins
- Understand the role of lipoproteins in the metabolism of different lipids
- Classify different types of hyper- and hypo-lipoproteinaemias.

**Fatty liver:**
- Understand and describe the role of the liver in the metabolism of lipids
- Differentiate the causes and effects of fatty liver

**Diabetes Mellitus:**
- Distinguish the types and metabolic changes of Diabetes mellitus
- Discuss the complication of diabetes as protein glycosylation, diabetic coma, ketoacidosis, hyperglycemic coma, and hypoglycemic coma
Integration of Metabolism
- Recognize the fuels used by active tissues
- Identify the caloric values of dietary constituents and the energy reserve of the body
- State the inter-conversion of the major foodstuffs
- Distinguish the metabolic interrelationship of the major tissues as liver, muscle, adipose tissue, kidney, and brain during different nutritional and hormonal status as in:
  - The well fed state
  - The starved state
  - Diabetes mellitus
  - Pregnancy and
  - Exercise
- understand the mechanisms and enzymes involved in switching the metabolism between the well-fed and the starved state

Nucleotide Metabolism
- Identify the structure and importance of purine and pyrimidine bases
- Recognize briefly the catabolic pathways of nucleotides
- Distinguish different congenital disorders related to nucleotide catabolism.

DNA Structure and Replication
- Know the 1ry, 2ry, and 3ry structures of DNA and its Watson and Crick model
- Understand the Chargaff rule
- Recognize the packing of DNA in chromosomes in the eukaryotic cells.
- Discuss initiation, elongation and termination of DNA replication both in eukaryotes and prokaryotes
- Identify different types and function of DNA polymerases
- Identify the causes, types and effects of DNA mutation
- Recognize different types and mechanisms of DNA repair

RNA structure and synthesis
- Know the structure and types of RNA molecules
- Discuss the initiation, elongation and termination of transcription
- Describe posttranscriptional processing of RNA molecules including trimming, insertion, base modifications, capping, poly A tailing and, slicing

Protein synthesis
- Know the characters of genetic code
- Discuss the steps of protein synthesis including the assembly of translation machine, initiation, elongation, and termination
- Describe the posttranslational processing of the newly formed proteins.

**Recombinant DNA Technology**

- Identify different tools required for recombinant DNA technology including restriction endonucleases, probes, and enzymes.
- Recognize restriction fragment polymorphism.
- Understand southern, northern, and western blot analyses and in situ hybridization.
- Understand and describe the polymerase chain reaction, procedure, benefits, and drawbacks.
- Understand and describe vectors, steps, and applications of DNA cloning.

**Hormones:**
1. List the different endocrine glands and hormones secreted by them.
2. Discuss the mechanism of action of each.
3. Discuss the chemical nature of each hormone and its synthesis.

**Renal Function Test:**
1. List the renal tests used to diagnose renal disease.
2. Discuss the biochemical changes in different renal disease.
3. Discuss the clinical picture of renal failure.

**Liver Function Test**
1. List the normal liver functions.
2. Discuss the biochemical changes taking place in liver disease.
3. Discuss the metabolism of heme.
4. Discuss jaundice.

**INSTRUCTION MEDIA**

1. **Lecturing Programme:**
   The discipline of biochemistry is presented theoretically to the student into 276 hours covering as much as possible of its objectives and is continuously updated.
   It has to be emphasized that it is not possible or desirable to cover the whole specialty by any number of lectures. Bearing in mind the limitation of lecturing as teaching method, the objectives of lectures should be:
   a. To cover the Basic Minimal knowledge required by all 1st professional students.
   b. To utilize the available time (first 15 minutes are spent tasking oral questions for the previous lectures) and (rest of 45 minutes) in presenting the knowledge as simple, updated, simply illustrated and easily understood as possible.
Participation of the student is essential even during the very traditional lectures. Therefore, certain subjects as well as some metabolic diseases like D.M., will be given to an individual student or group of students to be prepared and presented before the class.

At the beginning of the course and all over the year, a brief knowledge and understanding is given to the students, which must be supported and expanded by their own efforts. At the beginning of each year, a list of Biochemistry lectures for that year, with the objectives of each lecture, is distributed to the teacher concerned. Topics of the lectures for the academic year 2004-2005 are listed as follows:

### TOPICS OF LECTURES

** FOR
The Academic year 2004-2005
FIRST YEAR
1st Semester

**Physical chemistry**
- I. Chemical bonds (Strong & Weak)
- II. Chemical reactions (reversible & irreversible).
- III. Equilibrium constants, dissociation constant and pK.
- IV. Dissociation of water, pH, Henderson and Hassebalch equation.
- V. Buffers and their biomedical importances.
- VI. Importance of different buffer systems of the body.

**Structure of Carbohydrates**
- I. Overview
- II. Classification and Nomenclature of Carbohydrates
- III. Structure of Monosaccharides
- IV. Reactions involving Monosaccharides
- V. Digestion of Carbohydrates

**Amino Acids**
- I. Overview
- II. Structure of Amino Acids
- III. Acid/Base Properties of Amino Acids
- IV. Other Applications of the Henderson-Hasselbalch Equation

**Structure of Proteins**
- I. Overview
- II. Primary Structure of Proteins
- III. Secondary structure of Proteins
- IV. Tertiary Structure of Globular proteins
- V. Quaternary Structure of Proteins
- VI. Denaturation of Proteins
**Fibrous Proteins**  
- Collagen  
- Elastin

**Enzymes**  
I. Overview  
II. Nomenclature  
III. Properties of Enzymes  
IV. How Enzymes Work  
V. Factors Affecting Reaction velocity  
VI. Michaelis-Menten Equation  
VII. Inhibition of Enzyme Activity  
VIII. Regulation of Enzyme activity  
IX. Enzymes in Clinical Diagnosis

**Cell Structure and Functions:**  
- Types of cells.  
- Cell organelles  
- Biological membrane structure and functions.

**Nutrition**  
I. Overview  
II. Nutrient Requirements in Humans  
III. Energy Requirements in Humans  
IV. Macronutrients  
V. Minerals  
VI. Dietary Recommendations

**Minerals and Trace Elements:**  
- Sources.  
- Absorption.  
- Blood level and its control  
- Disorders.

**Vitamins**  
I. Overview  
II. Vitamin Supplements  
III. Water-Soluble Vitamins  
IV. Fat-Soluble Vitamins.

**Lipids:**  
- Chemistry  
- Structure:
- Biochemical importance and functions.
- Classification, Physical and chemical reactions, Hydrolysis, Saponification, hydrogenation, Peroxidation.
- Cholesterol and its derivatives.

**Globular Proteins**
I. Overview
II. Globular hemoeproteins
III. Hemoglobinopathies.

**TOPICS OF LECTURES**
**FOR**
The Academic year 2004-2005
**FIRST YEAR**
**2nd Semester**

**Basic Concepts of Metabolism**
I. Overview.
II. Metabolic map.
III. Catabolic and Anabolic Pathways.
IV. Regulation of metabolism.
V. Transduction by Intracellular Receptors.
VI. Transduction by Cell-Surface Receptors.
VII. Intracellular messenger Systems.
VIII. Other Messenger Systems.

**Glycolysis**
I. Overview.
II. Transport of Glucose into Cells.
III. Reactions of Glycolysis.
IV. Alternate Fates of Pyruvate.
V. Energy Yield of Glycolysis.
VI. Clinical Notes.
VII. Hormonal Regulation of Glycolysis.

**Gluconeogenesis**
I. Overview.
II. Reactions Unique to Gluconeogenesis.
III. Substrates for Gluconeogenesis.
IV. Regulation of Gluconeogenesis.

**Citric Acid Cycle**
I. Overview.
II. Reactions of the Citric Acid Cycle.
III. Stoichiometry of the Citric Acid Cycle.
IV. Regulation of the Citric Acid Cycle.

**Hexose Monophosphate Pathway**
I. Overview.
II. Oxidative Reactions.
III. Nonoxidative Reactions.
IV. Uses of NADPH.
V. Glucose 6-Phosphate Dehydrogenase Deficiency.

**Metabolism of Monosaccharides and Disaccharides**
I. Overview.
II. Fructose Metabolism.
III. Galactose Metabolism.
IV. Lactose metabolism.

**Glycogen metabolism**
I. Overview.
II. Structure and Function of Glycogen.
III. Synthesis of Glycogen.
IV. Degradation of Glycogen (Glycogenolysis).

**Glycosaminoglycans**
I. Overview.
II. Structure of Glycosaminoglycans.
III. Structure of Proteoglycans.
IV. Synthesis of Glycosaminoglycans.
V. Degradation of Glycosaminoglycans.
VI. Mucopolysaccharidoses.

**Glycoproteins**
I. Overview.
II. Structure of Glycoproteins.
III. Synthesis of Glycoproteins.
IV. Lysosomal Degradation of Glycoproteins.

**Nitrogen Metabolism**

**Amino Acids: Disposal of Nitrogen**
I. Overview.
II. Overall Nitrogen Metabolism.
III. Digestion of Dietary Proteins.
IV. Transport of Amino Acids into Cells.
V. Removal of Nitrogen from Amino Acids.
VI. Urea Cycle.
VII. Metabolism of Ammonia.

**Amino Acids: Metabolism of Carbon Skeletons**
I. Catabolism of the Carbon Skeletons of Amino Acids.
II. Role of Folic Acid in Amino Acid Metabolism.
III. Biosynthesis of Nonessential Amino Acids.
IV. Metabolic Defects in Amino Acid Metabolism.

**Conversion of Amino Acids to Specialized Products**
I. Overview.
II. Synthesis and Degradation of Porphyrins.
III. Creatine.
IV. Synthesis of Histamine.
V. Serotonin.
VI. Catecholamines.
VII. Melanin.

**Bioenergetics and Oxidative Phosphorylation**
I. Overview.
II. Free Energy.
III. ATP as an Energy Carrier.
IV. Electron Transport Chain.
V. Oxidative Phosphorylation.

**Metabolism of Dietary Lipids**
I. Overview.
II. Digestion, Absorption, Secretion, and Utilization of Dietary Lipids.

**Fatty Acid and Triacylglycerol Metabolism**
I. Overview.
II. Structure of Fatty acids.
III. De Novo Synthesis of Fatty Acids.
IV. Mobilization of Stored Fats and Oxidation of Fatty Acids.
V. Specialized Fatty Acids: Prostaglandins and Related Compounds.
VI. Ketone Bodies: An Alternate Fuel for Cells.

**Phospholipid Metabolism**
I. Overview.
II. Structure of Phospholipids.
III. Synthesis of Phospholipids.
IV. Degradation of Phospholipids.
Glycolipid Metabolism
I. Overview.
II. Structure of Glycosphingolipids.
III. Synthesis of Glycosphingolipids.
IV. Degradation of Glycosphingolipids.
V. Sphingolipidoses.

Cholesterol and steroid Metabolism
I. Overview.
II. Structure of Cholesterol.
III. Synthesis of Cholesterol.
IV. Degradation of Cholesterol.
V. Bile Acids and Bile Salts.
VI. Plasma Lipoproteins.
VII. Steroid Hormones.

Metabolic Effects of Insulin and Glucagon
I. Overview.
II. Insulin.
III. Glucagon.
IV. Hypoglycemia.

Metabolism in the Well-Fed State
I. Overview.
II. Enzymatic Changes in the Fed State.
III. Liver: Nutrient Distribution Center.
IV. Adipose Tissue: Energy Storage Depot.
V. Skeletal Muscle.
VI. Brain.
VII. Summary of Absorptive State.

Metabolism in Starvation, Diabetes Mellitus, and Injury
I. Overview of Starvation.
II. Fuel Stores
III. Enzymic Changes in Starvation
IV. Liver in Starvation.
V. Adipose Tissue in Starvation
VI. Skeletal Muscle in Starvation.
VII. Brain in Starvation.
VIII. Overview of Diabetes Mellitus.
IX. Insulin-Dependent Diabetes Mellitus.
X. Non-Insulin-Dependent Diabetes.
XI. Chronic Effects of Diabetes
XII. Metabolic Response to Stress.
**Nucleotide Metabolism**

I. Nucleotide Structure  
II. Degradation of Purine Nucleotides.  
III. Degradation of Pyrimidine Nucleotides.  
VI Diseases related to purine and pyrimidine degradation.

**DNA Structure and Replication**

I. Overview.  
II. Structure of DNA.  
III. Steps in Prokaryotic DNA Synthesis.  
IV. Organization of Eukaryotic DNA.  
V. Mutation  
VI. DNA Repair

**RNA Structure and Synthesis**

I. Overview.  
II. Structure of RNA.  
III. Transcription of Prokaryotic Genes.  
IV. Transcription of Eukaryotic Genes.  
V. Post-Transcriptional Modification of RNA.

**Protein Synthesis**

I. Overview.  
II. The Genetic Code.  
III. Components Required for Translation.  
IV. Steps in Protein Synthesis.  
V. Post-Translational Modification of Polypeptide Chains.

**Recombinant DNA technology:**

I. Restriction endonucleases  
II. DNA probes  
III. Nucleic acid extraction  
IV. Southern blot analysis  
V. Polymorphism  
VI. Polymerase chain reaction  
VII. DNA cloning

**SECOND YEAR**

**Renal Function test**

1- Glomerular function test.  
2- Tubular function test.  
3- Causes of glomerular dysfunction.  
4- Causes of tubular dysfunction.  
5- Biochemical changes in renal disease including acute and chronic renal failure.
**Liver function tests:**
1- Normal liver function.
2- Jaundice.
3- Major pathological changes in liver disease.

**Hormones:**
1- Chemical nature of each hormone.
2- Mechanism of action.

**BIOCHEMISTRY PRACTICALS**

Practical programme is designed mainly to cover ultimate practical objectives in 36-practical sessions, each session for 2 hours/week. (72 hours) Students are trained to perform work in the Bio.Lab.
- Students are oriented to general laboratory equipment (glassware, centrifuge machine, electric balance and photoelectric colorimeter).
- Students should be able of performing volumetric analysis.
- To prepare Molar (M) milimolar (mM) and normal (N) solutions.
- They should carry out the following titrations:
  - Acid-base.
  - They should perform the experiments to identify carbohydrates and proteins in a given unknown solution after having a good idea about the physical and chemical properties of the carbohydrates and proteins.
  - They should have a practical knowledge about some properties of lipids.
  - Factor affecting rate of enzymatic reaction.
  - They should be capable of performing examination of urine physically, chemically and microscopically and are able to identify certain important urinary sediments.
  - They should be able to handle blood samples and to work with photoelectric colorimeter to estimate the following constituents in blood /serum or using plasma.
  - Total plasma proteins and A/G ratio.
  - Uric acid.
  - Glucose and glucose tolerance curve.
  - Cholesterol.
  - They should be aware of performing organ function tests by estimating the following in blood /plasma or serum:
    - Liver function tests:
    - Alkaline phosphatase.
    - Aspartate transaminase (AST).
    - Alanine transaminase (ALT).
    - Bilirubin (direct and indirect).
    - Kidney function tests:
    - Complete urine analysis.
    - Urea and urea clearance.
    - Creatinine and creatinine clearance.
These are tutorials meant to cover the terminal objectives of the course.

**List of tutorial topics of this year:**
Cell, Physical chemistry, chemistry of carbohydrates, lipids, proteins, purine and pyrimidine, vitamins, minerals, nutrition, general metabolism, of carbohydrates, proteins, lipids, purine and primidines, hormones, enzymes & enzyme kinetics, biological oxidation, haemoglobin, myoglobin and immunoglobulins, individual amino acid metabolism and metabolic disorders, DNA structure and replication, RNA structure, transcription & genetic code, post transcriptive modification and control of genetic expression, translation and post-translative modification, neurotransmitters, tumor markers and biomedical importance, connective tissue chemistry, liver function tests and their biomedical importance.
Kidney function tests and their biomedical importance.
THE EVALUATION POLICY

GENERAL OUTLINES:

1. The evaluation policy is designed not only to assess the process of learning of every individual student but also to upgrade the teaching/learning procedures.
2. The policy is designed to correspond and implement the outline of the evaluation policy of the preclinical faculty. The examination modes have to fit in harmony with the objectives of the under-graduate curriculum and the course of Biochemistry.
3. The evaluation plan is to be made available to the students and the teachers. Their remarks have to be considered and continuous review of the plan is essential for its promotion. Final examination is to be conducted by an examination board of internal and external examiners selected by the Dean/Vice Dean of the college. The examination plan is to be prepared in advance according to the examination bye-laws as decided by the pre-clinical faculty board.
4. End term examinations are an internal affair in the department of Biochemistry and are planned accordingly.
5. The evaluation process should test all the knowledge, skills, attitudes and values of the students and should be used to discover and correct weaknesses as well as for promotion and certification.
6. Whenever there is more than one examination board working together, uniformity of examinations as decided by the pre-clinical faculty board.

Semester Examination and Continuous Evaluation:
1\textsuperscript{st}, and 2\textsuperscript{nd} semester:

a. Objectives:-
- To assess teaching programme, procedures and to detect weaknesses of students.
- To evaluate each individual student.
- To assess the standard of the students.

b. Duration: Total 46 weeks divided into two semesters.

c. Examination:- The final examinations will be held at the end of each semester; i.e. 2 times (1\textsuperscript{st} semester \(\rightarrow\) Dec/Jan.; 2\textsuperscript{nd} semester \(\rightarrow\) June / July) every year at the conclusion of the revision course. The examination will be conducted by board of internal and external examiners (usually 3 members) according to plan prepared in advance.

The written examination: Consists of paper I and II as Biochemistry syllabus is divided between two staff members during the year, each paper consists of

d. Procedures:
   1. Written Examination:-
      - Consisting of 40 multiple choice questions,
      - Comletion of biochemical reactions;
- Differences between two terms;
- Identification of important structures;
- Short accounts;
- Long accounts;

2. **Practical Examination:** consisting of two experiments lasting from two to two and half hours.

3. **Viva Voce examination:** An interview of each student by the examination board and consists of verbal discussion lasting for 10 minutes.

**Assessment of the Student:**
It is calculated as 30% of the total marks allotted for the subject, including Tutorials, class sharing, attendance, behavior and practical work performed recorded in notebooks during the year.

**Distribution of Marks:**
Total mark is calculated from 220 distributed as follows:

<table>
<thead>
<tr>
<th>Written Practical Oral Assessment (Yearly)</th>
<th>35% 20% 15% 30%</th>
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<tbody>
<tr>
<td>Marking scale</td>
<td>Pass Good Very Good Excellent</td>
</tr>
<tr>
<td>60% - 64.9 %</td>
<td></td>
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<tr>
<td>65% - 74.9 %</td>
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<tr>
<td>75% - 84.9%</td>
<td></td>
</tr>
<tr>
<td>85 % and above</td>
<td></td>
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</tbody>
</table>
References

Prescribed Books:
1. Harper's Biochemistry
   Maray, Granner, Mayes, and Rodwell a Lang medical book.
   Apleton & Lange
   San Mateo, CA/Norwalk,CT

2. Biochemistry
   Stryer, Lubert
   Freeman
   ISBN O-7167-1306-3

3. Biochemistry
   (Part I, II, III & IV)
   Ali Khalifa Ali
   University Book Centre
   8 Soliman El-Halaby Street
   Cairo

4. Biochemistry
   Ian D.K.Halkerston
   Lan Series for Independent study
   Williams & Wilkins
   Harwal Publishing Company, Malvern, Pennsylvania

5. Biochemistry Illustrated
   Peter, Campbell, Anthony and Smith
   Churchill Livingstone
   Wilture Enterprises (International) Ltd.

6. Lippincott's Illustrated
   Results
   Pamela
   Champe
   J.B. Lippincott Company.