**Jimma University**

**College of Natural Sciences**

**Department of Chemistry**

**Biochemistry (Chem 3116) Course outline**

**Course objective**

Upon completion of the course students should be able to:-

* *Define biochemistry and understand its scope*
* *Understand cellular and chemical bases of life*
* *Understand physical and chemical properties of water, acids, bases and buffer.*
* *Identify the main classes of biomolecules and their monomeric building blocks.*
* *Understand the structure and function of biomolecules and separation and purification techniques in modern biochemistry.*
* *Explain the specificity of enzymes (biochemical catalysts), and the chemistry involved in enzyme action.*
* *Understand Enzyme kinetics and different modes of enzyme inhibition.*
* *Understand thermodynamics which dictates the direction and regulation of metabolic pathways, common intermediates of metabolism: High – Energy compounds, ATP and Δ G, redox reactions, the mechanisms by which metabolic reactions are controlled.*
* *Understand the main theme of carbohydrate and central metabolism: Glycolysis, Krebs Cycle, electron transport and oxidative phosphorylation*
* *Describe how selected lipids, amino acids and nucleotides are metabolized.*

**Course outline**

1. **Introduction to biochemistry ------------------------------------------------------------------------------3hrs**
   1. Definition and scope of biochemistry
   2. Cellular and Chemical bases of biochemistry
   3. Chemical and biological reactions
   4. Application area of biochemistry
2. **Water, PH, and buffer-------------------------------------------------------------------------------------1hr**

2.1. Introduction

2.1.1. Unusual properties of water

2.1.2. Role of water in biological system

2.1.3. Intermolecular forces

2.1.4. Colligative properties

2.2. Hydronium ion and pH

2.3. Buffers and buffering agent

2.4. Some common buffers in living systems

1. **Amino acids ,peptides and Proteins----------------------------------------------------------------------6 hrs**

3.1 Structure of Amino Acids

3.1.1 Introduction

3.1.2 Structure of Amino Acids

3.1.3 Amino Acids as Buffers

3.1.4 A peptide Bond

3.2 Structure of Proteins

3.2.1. Primary Structure

3.2.2. Secondary Structure

3.2.3. Tertiary Structure

3.2.4. Quaternary Structure

3.3. Denaturation of Proteins

* 1. Importance of Proteins

**4. Enzymes---------------------------------------------------------------------------------------------------5hrs**

4.1. Definition of Enzymes

4.2. Properties of Enzymes

4.3. Major Classes of Enzymes

4. 4. Enzyme Kinetics

4.5. Mechanism of enzyme catalysis

4.6. Regulation of enzyme activity

**Test 1 (15%- on chapters 1-4)**

**5. Lipids (Poster presentation ) ---------------------------------------------------------------------- 4 hrs**

5.1. Definition of lipids

5.2. Fatty acids

5.3. Triacylglycerols

5.4. Polar lipids

5.5. Steroids and other lipids

5.6. Biological membranes

5.7. Membrane transports

**Assignment 1 (Poster presentation on topics in this chapter-5%)**

**6. Carbohydrates ---------------------------------------------------------------------------------------3 hrs**

* 1. Definition and Classification
  2. Monosaccharides
  3. Disaccharides
  4. Polysaccharides

**7. Nucleotides and polynucleotides -----------------------------------------------------------------2 hrs**

* 1. Structural components of nucleotides
  2. Polynucleotides (DNA and RNA)
  3. Biological role of nucleotides and polynucleotides

**Test 2 (15%- on Chapters 5-7)**

1. **Introduction to Metabolism--------------------------------------------------------------------2 hrs**
   1. Metabolic Pathways

8.2 Bioenergetics (ATP)

* 1. Regulations of metabolism

**Assignment 2 (Term paper presentation based on selected topics related with this course-15%)**

**9. Carbohydrate and central Metabolism --------------------------------------------------------------------6 hrs**

9.1 Overview of Carbohyate metabolism

9.2 Digestion of Carbohydrates

9.3 Glycolysis

9.3.1 Fates of pyruvate

9.3.2 Energy yield of Glycolysis

9.4 Citric Acid Cycle

9.5 Electron Transport Chain and Oxidative Phosphorylation

9.6 Glycogen Metabolism

9.7 Gluconeogenesis

* 1. Pentose Phosphate pathway (PPP or HMP)

**10. Lipid Metabolism------------------------------------------------------------------------4 hrs**

10.1 Introduction

10.2 Metabolism of Dietary Lipids

10.2.1 Overview

10.2.2 Digestion and absorption, of dietary Lipids

10.3 Fatty Acid and Triacylglycerol metabolism

10.3.1 Mobilization of Stored Fats a

10.3.2 Oxidation of Fatty Acids

10.3.3 Ketogenesis

10.4 Phospholipid Metabolism

**11. Metabolism of Amino Acids and Nucleic Acid ------------------------------------4 hrs**

11.1 The Nitrogen cycle

11.2 Amino Acid metabolism

11.2.1 Catabolism of amino acids

11.2.1.1 Digestion of dietary Proteins

11.2.1.2 Removal of nitrogen from amino acids

11.2.1.3 Removal of carbon skeletons of amino acids

11.2.1.4 The Urea Cycle

11.2.2 Biosynthesis of nonessential amino acids

11.2.3 Conversion of amino acids into specialized products

11.3 Nucleic acid metabolism

11.3.1 Catabolism of the nucleotides & polynucleotides

11.3.1.1 Digestion of nucleotides & polynucleotides

11.3.1.2 End products of degradation of nucleotides & polynucleotides

11.3.2 Biosynthesis of nucleotides pyrimidine nucleotides

11.3.2.1 *De nove* synthesis of purine and pyrimidine nucleotides

11.3.2.2 Salvage pathways for biosynthesis of purine and pyrimidine nucleotides

11.3.2.3 Biosynthesis of deoxyribonucleotides

***Mode of Course delivery:-*** Gaped lecture, group discussion, independent/group activity, Project work, Note summary,

Poster presentation

***Mode of evaluation:***

Continuous assessment (Tests, assignments, group presentations etc.)--------------- 50%

Final examination---------------------------------------------------------------------------- 50%

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**Total**  **100%**

**References:-**

1. Albert L. Lehninger, David L. Nelson and Michael M. Cox. ***Principles of Biochemistry***, 3rd Ed., Worth Publishers, New York, 2000.
2. Donald Voet and Judith Voet. ***Biochemistry.***Wiley-Liss, Inc., New York, 1995
3. Lubert Stryer and W.H. Freeman. ***Biochemistry***, 4th Ed., New York, 1995.
4. Champe C., Harvey, J.B and Richard A. ***Biochemistry***, 2nd Edition, Lippincott Co., Philadelphia, PA, 1997.