



Department of Biology

College of Science

University of Salahaddin

Subject: Biochemistry

Course Book – (Year 2)

**Lecturer's name: Abdulkarim Yasin Karim
(PhD), Trefa Salihmad Mohamad (PhD) and
Zhyan Latif (MSc)**

Academic Year: 2018/2019

Course Book

1. Course name	Biochemistry
2. Lecturer in charge	Asst. Prof. Dr Abdulkarim Y. Karim & MSc Zhyan Latif
3. Department/ College	Biology & Chemistry/Science
4. Contact	e-mail: abdulkarim.karim@su.edu.krd Tel: (optional)
5. Time (in hours) per week	Theory: 2 Practical 3
6. Office hours	To be Return to the schedule on the office door
7. Course code	SBio 205
8. Teacher's academic profile	<ul style="list-style-type: none"> ○ Lab. Instructor in Department of Biology, College of Science at Salahaddin University, Erbil, Kurdistan/Iraq: 1998-2000. ○ In 2003 got master and worked as assistant Lecturer in Department of Biology, College of Science at Salahaddin University, Erbil, Kurdistan/Iraq: 2003-2004. Teaching Medical Bcteriology and Medical Parasitology ○ Got PhD degree in Biotechnology, Faculty of Biochemistry, Biophysics and Biotechnology at the Jagiellonian University, Krakow, Malopolska/Poland: 2005-2010. ○ Got Postdoctorate research associate, Faculty of Biochemistry, Biophysics and Biotechnology at the Jagiellonian University, Krakow, Malopolska/Poland and Department of Structural Biology of the Molecular Biology Institute of Barcelona (CSIC, Barcelona, Spain): 2010-2012. ○ Assistant Professor in Department of Biology, College of Science at Salahaddin University, Erbil, Kurdistan/Iraq: Teaching Biochemistry and Molecular biology. ○ Teaching and supervising master and PhD students. ○ Member of the Examination Committee for College of Science 2003 and 2014.
9. Keywords	Carbohydrates, Lipids, Nucleic acids, Proteins, Enzymes, Vitamins, Metabolism
10. Course overview:	<p>▪ The chemistry of living organisms and their components, including biosynthesis and metabolism of carbohydrates, lipids, nucleic acids and proteins. It seeks to understand the</p>

relationship between the structure and function of the molecules that make up living organisms. This is no easy task because of the enormous diversity and complexity of life processes. There is a broad overlap between biochemistry and all of the other sciences that study living organisms, from microorganisms to plants, animals, and human beings. Areas as diverse as cell and molecular biology, genetics, physiology, toxicology, drug design, nutrition, forensic science, and environmental science all use biochemistry techniques and methods. Some biochemists try to explain how the molecules that make up the human body function. They identify the molecules and determine how the molecules are produced, how they interact with each other, and the results of the chemical reactions they undergo. This course is intended to meet the needs of students wishing to gain and appreciation of biochemistry through the survey of basic biochemical pathways common to prokaryotes, plants and animals. The overarching aim is to provide foundational level of understanding of the biochemical mechanisms of cell function. The goal is to enhance one's knowledge and to benefit the student's future endeavors within all areas of the life science, and in their day to day personal lives as well.

11. Course objective:

By the end of the course, the students should be able to demonstrate advanced knowledge and understanding in the following core areas:

- Essential information about the subject.
- Carbohydrates: General information, formation of ring structures of Carbohydrates: monosaccharide , oligo- and polysaccharides, reducing sugar and non- reducing sugar.
- Lipids: Physiological role of lipids, fatty acids – saturated and unsaturated, Oxidation and hydrogenation of fatty acids, triacylglycerols – Overview, glycolipids, phospholipids, sphingolipids, structure, physiological role, prostaglandins, waxes, cholesterol, lipid digestion and absorption.
- Nucleic acids: Physiological role of nucleic acids, nitrogenous bases, nucleotides, DNA structure and function, RNA structure and functions.
- Amino acids, Peptides and Proteins: physicochemical and biological properties of amino acids, peptide bond – formation and properties, peptides – general properties, nomenclature, and importance for living organisms , structure and denaturation of proteins
- Enzymes: Structure and mechanism of action of enzymes, active site, effects of different factors on enzymatic activity, cofactors, coenzymes, nomenclature and classification of enzymes, enzyme activity and kinetics, enzyme inhibitors, isoenzymes, enzyme specificity, regulation of enzyme action in cells, regulatory enzymes and their control three-dimensional structures of enzymes.
- Vitamins: water soluble and fat soluble vitamins
- Introduction to metabolism
- Metabolism of carbohydrates: Carbohydrates - general information, glycolysis (chemical strategy of glycolysis, basic types of reactions in glycolysis, reactions of glycolysis, energy balance of glycolysis, Regulation of glycolysis (alternative fates of glycolytic intermediates), gluconeogenesis (reactions and localization in the cell, regulation and energy balance), Entry

of other carbohydrates into the glycolysis (monosaccharides -fructose, mannose , galactose, disaccharides), the Cori cycle, pentose phosphate pathway (importance, localization, reactions and regulation), key intermediates of metabolism, metabolic fates of pyruvate, pyruvate dehydrogenase complex, G6PD deficiency. Citric Acid Cycle Overview of the citric acid cycle, reactions and regulation of the citric acid cycle (CAC), amphibolic character of the CAC. Respiratory Chain and Oxidative Phosphorylation Significance, localization, composition and function of complexes, cytochromes, inhibition of respiratory chain.

- Metabolism of lipids: Physiological role of lipids, fatty acids - the chemical nature , triacylglycerols – biosynthesis and degradation, control, utilization of fatty acids for energy production - activation, transport and reaction sequence for degradation, modifications of oxidative degradation, energy yield, regulation.
- Glycogen metabolism: Biosynthesis, breakdown and regulation, activation of kinases and phosphorylases, different metabolic pathway of glucose in various cells
- Metabolism of amino acids: Urea cycle – reaction sequence, control of urea cycle, location, metabolic degradation of AA carbon skeletons (individual AA).
- Nucleotide metabolism

12. Student's obligation

*Exam policy: Student Should take 3 exams during the year. There will be no make-up exams for absences students without medical report.

*Classroom polices:

1- Attendance: You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. You are responsible for obtaining any information you miss due to absence

2- Lateness: Lateness to class is disruptive

3- Electronic devices: All cell phones are to be turned off at the beginning of class and put away during the entire class.

4-Talking : During class please refrain from side conversations. These can be disruptive to your fellow students and your professor

5- No Disrespectful to both the teacher and to your fellow students.

13. Forms of teaching

By using PowerPoint, Data Show and classroom Board.

14. Assessment scheme

Exam1	Week9	25%
Exam2	Week18	25%
Exam3	Week28	25%
Activity and all year attendance		10%
Quizzes		15%
Total		100%

15. Student learning outcome:

1. Possess a general understanding of the major types of biochemical molecules, including small, large and supermolecular components found in cells;
2. Be able to immediately recognize the different types of biochemical molecules and

<p>know their essential chemical characteristics that make them indispensable for life;</p> <ol style="list-style-type: none"> 3. Understand basic energy metabolism of cells; 4. Identify some of common reaction mechanisms in biochemical processes; 5. Recognize the value of the importance of biochemistry in everyday life 6. Comprehend the role biochemistry in the practice of medicine and medical research; 7. Appreciate the potential of basic science advances in biochemistry in the development of translational applications leading to new therapies and treatments in the fight against diseases, genetic maladies, and chronic health conditions;

16. Course Reading List and References:

- Key references:
 - Harpers Biochemistry, by Robert k Murray *etal*, 2003
 - Biochemistry, by Pamela C. Champe *etal*, 2008
 - Any websites and articles about biochemistry

17. Theory Topics:

week	Topics
1	Introduction to Biochemistry: Essential information about the subject
2	Carbohydrates I: General information, formation of ring structures of carbohydrates: monosaccharide
3	Carbohydrates II: Disaccharides, oligo- and polysaccharides, reducing sugar and non- reducing sugar
4	Lipids I: Physiological role of lipids, fatty acids – saturated and unsaturated, Oxidation and hydrogenation of fatty acids
5	Lipids II: Triacylglycerols – Overview, glycolipids, phospholipids
6	Lipids III: Sphingolipids, structure, physiological role, prostaglandins, waxes, cholesterol,
7	Lipids IIII: Lipid digestion and absorption
8	Nucleic acids: Physiological role of nucleic acids, nitrogenous bases, nucleotides, DNA structure and function, RNA structure and functions
9	Exam1
10	Proteins I: Amino acids, Peptides and Proteins: physicochemical and biological properties of amino acids, peptide bond – formation and properties, peptides – general properties, nomenclature, and importance for living organisms.
11	Proteins II: Structure and denaturation of proteins
12	Enzymes I: Structure and mechanism of action of enzymes, effects of different factors on enzymatic activity, cofactors, coenzymes, nomenclature and classification of enzymes
13	Enzymes II: Enzyme activity and kinetics, enzyme inhibitors, isoenzymes, enzyme specificity
14	Enzyme III: Regulation of enzyme action in cells, regulatory enzymes and their control three-dimensional structures of enzymes
15	Vitamins: Water soluble and fat soluble vitamins
16	Introduction to metabolism

17	Metabolism of carbohydrates I: Carbohydrates - general information, glycolysis (chemical strategy of glycolysis, basic types of reactions in glycolysis, reactions of glycolysis, energy balance of glycolysis)
18	Exam2
19	Metabolism of carbohydrates II: Gluconeogenesis (reactions and localization in the cell, regulation and energy balance), Entry of other carbohydrates into the glycolysis (monosaccharides -fructose, mannose , galactose, disaccharides), the Cori cycle
20	Metabolism of carbohydrates III: Disorders of carbohydrate metabolism
21	Metabolism of carbohydrates III: The pentose phosphate pathway and G6PD deficiency
22	Citric Acid Cycle: Overview of the citric acid cycle, reactions and regulation of the citric acid cycle (CAC)
23	Respiratory Chain and Oxidative Phosphorylation: Significance, localization, composition and function of complexes, cytochromes, inhibition of respiratory chain.
24	Metabolism of lipids I: Physiological role of lipids, fatty acids - the chemical nature , triacylglycerols – biosynthesis and degradation, control
25	Metabolism of lipids II: Utilization of fatty acids for energy production - activation, transport and reaction sequence for degradation, modifications of oxidative degradation, energy yield, regulation.
26	Glycogen metabolism: Biosynthesis, breakdown and regulation, activation of kinases and phosphorylases, different metabolic pathway of glucose in various cells
27	Metabolism of amino acids: Urea cycle – reaction sequence, control of urea cycle, location, metabolic degradation of AA carbon skeletons (individual AA).
28	Exam3
29	Heme and Hemoglobin: Synthesis of heme and its regulation, metabolism of heme to bile pigments,
30	Nucleotide metabolism

Practical Topics

They are divided to the blocks

{ B 1 } : Carbohydrates

- 1- Laboratory roles and safety.....1st week
- 2- Molisch,s test..... 2nd week
- 3- Reactions of reducing sugars including.....3rd week.
- 4- Test for individual carbohydrates including..... 4th week
- 5-The hydrolysis of polysaccharides..... 5th week
- 6- identification of an unknown carbohydrate..... 6th week

It is examination about the carbohydrates by using the scheme

{ B2 } Chemical And physical properties of amino acids and proteins

Qualitative tests

- 1- The solubility of amino acids.....7th week

2- Ninhydrin reaction	
3- Xanthoproteic reaction.....	8 th week
4-The Biuret test for peptide bonds	
5- Denaturation and Precipitation of portions including	
5:1- by heat and Heavy metal	9 th week
5:2- by Precipitation of protein by ammonium sulfate	10 th week
5:3- Denaturation of protein by organic solvents.....	11 th week

	-{B 3 } : LIPIDS
AND MEMBRANES	
Qualitative tests for Lipids.....	12 th week
1-The solubility of lipids	
2-Grease test	
3-Tests for unsaturated fatty acids	
4-Tests for triacyl glycerol.....	13 th week
5- Tests for cholesterol	
1.Lieberman test	
2. Salkowaski test	
Quantitative Analysis of Lipids	
1- The determination of the peroxide value of a fat	14 th week
1. Determine the rancidity in the fat	
2. Determine the peroxide value in fat	
2- The determination of the acid value of a fat.....	15 th week
Exam in the B1,B2,B3.....	16 th week

	-{ B4 } : ENZYMES
1- Enzymes classification	17 th week
1. Catalase by using H ₂ O ₂ which is act as substrate	18 th week
2. Peroxidase by using 4 amino antipyrine reagent	19 th week
3. Polyphenol oxidase by using catechole	20 th week
2- factors affecting the rate of the enzyme activity	
1:Temperature	21 th week
2: pH	22 th week
2: Substrate concentration.....	23 th week
3- Determination of ascorbic acid	24 th week
4- Dialysis and separation of large molecule	25 th week
5- electrophoresis	26 th week

Clinical Chemistry Assay	
-{ B5 }1. Blood chemistry sampling	27 th week
2-urinary analysis	28 th week

Determination the element in the urine by the physical, chemical and microscopic analysis.

2. Determination of the blood sugar.....29th week.

-{B6 } : liver function test including.....30th week

- 1.T.protein
2. Bilirubin test

Lipid profile test 31th week
Total Cholesterol

Practical examination in general tests.....32th week

19. Examinations:

Question/ What is the reason monosaccharides much more water soluble than most molecules of similar MW?

Answer/ Because the presence of large numbers of OH groups found in monosaccharides.

Question/ Describe Maltose intolerance disease?

Answer/ In humans, maltose is broken down by the enzyme maltase, the lack of maltase causes maltose intolerance, a patient suffers from this pathology when they have “stomach cramps, bloating, excess gas production, nausea, vomiting and diarrhea.

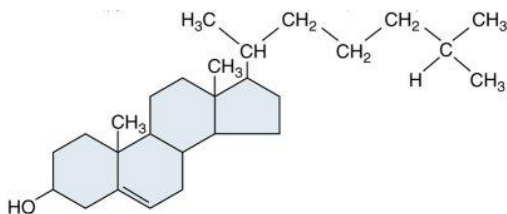
Question/ Explain how unsaturated fatty acids protect from oxidation?

Answer/

- sealed, non-metallic, protected from light, refrigerated
- addition of antioxidants
- saturate by adding hydrogen molecules (hydrogenated)

Question/ Make structure of Cholesterol?

Answer/



Question/ Select the most correct answer:

Binding inhibitor in allosteric site makes enzyme:

- a- unfit for substrate binding
- b- fit for substrate binding
- c- very fit for substrate binding

d- suit for substrate binding

Answer/ a

Question/ Fill the following blanks:

Chylomicrons are lipoprotein particles that consist of,
....., and

Answer/ triglycerides, phospholipids, cholesterol and proteins

20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

21. Peer review

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).