

## The University of Jordan

**School:** Medicine

**Semester:** Summer

**Course Name:** Introductory Biochemistry for Medical students

**Department:** Physiology and Biochemistry

**Academic Year:** 2015-2016

Lecturer	E-mail
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### Course Contents

Topic	No. of lectures	Professor	Reference	ILOs
Acids, bases, water, pH, and buffers	5	Dr. Naif + Dr. Diala	Campbell Chapter 2 35-57	A1-6
Carbohydrates	3	Dr. Naif + Dr. Diala	Campbell Chapter 16 451-477	A7-13
Lipids	4	Dr. Naif + Dr. Diala	Boyer Chapter 8 231-258	A14-17
Amino acids	2	Dr. Naif + Dr. Diala	Campbell Chapter 3 61-79	A18-23
Polypeptides and protein structure	2	Dr. Naif + Dr. Diala	Campbell Chapter 3,4 83-117	A24-30
Protein structure-function relationship (part I: fibrous proteins)	1	Dr. Mamoun+ Dr. Nafez	Campbell Chapter 3,4 83-117	A31-34
Protein structure-function relationship (part II: globular proteins)	1	Dr. Mamoun+ Dr. Nafez	Campbell Chapter 3,4 83-117	A31-34
Biochemical techniques	2	Dr. Mamoun+ Dr. Nafez	Campbell Chapter 5 117-135	A56-61
Enzymes (introduction)	2	Dr. Mamoun+ Dr. Nafez	Marks Chapter 8 112-133	A35-40
Enzymes (cofactors)	2	Dr. Mamoun+ Dr. Nafez	Marks Chapter 8 112-133	A41-43
Enzymes (kinetics)	2	Dr. Mamoun+ Dr. Nafez	Marks Chapter 9 112-133	A44-48
Enzymes (mechanism and regulation)	2	Dr. Mamoun+ Dr. Nafez	Marks Chapter 9 112-133	A49-55

## **Learning Objectives**

- Understand strong and weak acids and bases
- Metabolic sources of acids and bases
- The concept of pH and pKa
- Regulatory mechanism against changes of pH.
- Main physiological buffers and their actions.
- Describe the chemical structures of carbohydrates, lipids, amino acids and proteins, enzymes, co-enzymes and vitamins.
- Explain the chemical structures in relation to function of the macromolecules
- Appreciate the specificities and catalytic power of enzymes, understand the mechanisms of their actions and identify factors that affect their activity.
- Know the principles and applications of different biochemical techniques used in biological research.

## **Intended Learning Outcomes (ILOs):**

Successful completion of the course should lead to the following outcomes:

### **A. Knowledge and Understanding:** Student is expected to

- A1- Differentiate the types and characteristics of non-covalent interactions
- A2- pH and buffers : Recall the concepts of acids, bases, amphoteric molecules, and ionization of water and weak acids
- A3- Apply the molecular expressions: molarity, normality, equivalence, pH, and pKa.
- A4- Know the chemical concept of different types of buffers, buffering capacity, midpoint, and titration.
- A5- Apply the Henderson-Hasselbalch equation and mechanisms of buffer actions.
- A6- List of physiological buffers and translate knowledge in normal and abnormal condition.
- A7- Review of basic organic chemistry and functional groups in biomolecules.
- A8- Definition of Carbohydrates
- A9- Chemistry of Carbohydrates
- A10- Importance of Carbohydrates
- A11- Classification of Carbohydrates (e.g. mono and disaccharides)
- A12- Important disaccharides and polysaccharides
- A13- Differentiate proteoglycans and glycoproteins and carbohydrates linked to blood groups.
- A14- Define lipids and importance of lipids.
- A15- Identify the classifications, drawing, structure, and function of lipids (fatty acids, triglycerides, waxes, phospholipids, glycolipids, and steroids.
- A16- Differentiate the basic mechanism of lipid transport in blood
- A17- Recall the complex structure of cell membranes
- A18- Define proteins
- A19- List amino acids
- A20- Differentiate the structure, isomerism, classes of amino acids
- A21- Identify the ionization states of amino acids
- A22- Know the concept of isoelectric point
- A23- List modified and specialized amino acids

- A24- Recall of features of peptide bond
- A25- Apply the concept isoelectric point of amino acids to polypeptides
- A26- Recall the four levels of protein structure
- A27- Differentiate the different secondary structures of proteins and their structural significance
- A28- Understand the formation of tertiary structure of proteins
- A29- Define quaternary structure
- A30- Know the concept of complex protein structures (glycoproteins, lipoproteins, phosphoproteins)
- A31- Apply the concepts of denaturation and renaturation to protein structure and function
- A32- Apply the previous information to pathological defects in protein formation
- A33- Recognize the different classes of proteins (fibrous, globular)
- A34- Discuss different proteins from each class I (mainly collagen, myoglobin, and hemoglobin) in connection to their function in light of previous knowledge
- A35- Define enzymes
- A36- Recall the general properties and functions of enzymes, ribozymes.
- A37- List the classes of enzymes and differentiate the reactions they catalyze
- A38- Recall the major features of active sites
- A39- Recall the concept of free energy and activation energy, transition state, abzymes.
- A40- Differentiate between holoproteins and apoproteins
- A41- Differentiate classes of cofactors
- A42- Define and list vitamins and understand their contribution in enzymatic reaction (coenzymes)
- A43- Identify the role of metals in enzyme activity of metal-activate enzymes
- A44- Define enzyme kinetics
- A45- Apply the concept of  $V_o$ ,  $V_{max}$ , and  $K_M$ , and their biological significance
- A46- Apply the above terms to the Michaelis-Menten equation
- A47- Apply the enzyme units to understand the following terms: (rate of reaction ( $V_o$ ),  $V_{max}$ , specific activity, turnover number).
- A48- Link the mechanisms of action of the different classes of inhibitors in relation to the Lineweaver-Burk or double-reciprocal plot
- A49- Describe how enzyme activity can be regulated by physiological and pharmacological inhibitors
- A50- Recall the concept of allosteric regulation
- A51- Identify the role of small and large enzyme regulatory molecules
- A52- Irreversible inhibition and suicide inhibition.
- A53- Define the various modes of enzyme regulation.
- A54- Discuss the effect of nonspecific inhibitors (temperature, pH) on protein structure and function
- A55- Define isoenzymes and know their biological and clinical significance (Clinical enzymology).
- A56- Application of centrifugation in cell fractionation.
- A57- Principal and applications of dialysis and gel filtration chromatography.
- A58- Various types of chromatography : ion exchange chromatography, affinity chromatography, HPLC.
- A59- Electrophoresis and isoelectric focusing.

A60- Colorimeter.  
A61- Immunological and molecular techniques.

- B. Intellectual Analytical and Cognitive Skills:** Student is expected to
- B1-Calculate pH and changes in pH according to different variables
  - B2-Predict changes in blood pH according to equilibrium of bicarbonate buffering system
  - B3-Differentiate between the various sugar molecules, lipids, and amino acids
  - B4-Calculate isoelectric point of small polypeptides
  - B5-Predict changes in enzyme kinetics according to inhibitor type
  - B6-Calculate enzyme units
  - B7-Determine enzyme class according to catalyzed reaction and involved cofactor
  - B8-Turn over number and specific activity.

### **Evaluation**

<b>Evaluation</b>	<b>Point %</b>
<b>Midterm Exam</b>	40%
<b>Lecture attendance</b>	10%
<b>Final Exam</b>	50%

### **Main Reference/s:**

Biochemistry; Mary K. Campbell and Shawn O. Farrell, Brooks Cole; 6<sup>th</sup> edition.  
Mark's Basic Medical Biochemistry by M. Lieberman of A.Marks , Lippincott, Williams and Wilkins, 2013. 4<sup>th</sup> edition, Concept in Biochemistry by R.Boyers

### **References:**

- NCBI Bookshelf:  
(<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books>)
- The Medical Biochemistry Page: (<http://web.indstate.edu/thcme/mwking/home.html>)
- Biochemistry, Garret and Grishan, Second Ed.: <http://web.virginia.edu/Heidi/home.htm>