**BIOL 313 Biochemistry (4 credits) Sec A**

**Spring 2023**

Instructor: Dr. Syed Farhat Ali

OFFICE S337

OFFICE HOURS M W F 10 am – 11 am or by appointment

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CLASS HOURS M W F 9:00 am – 9:50 am S417

Lab: M 2:00 am – 3:50 pm S329

**Course Contents**

The course is designed to provide understanding of the organic structure of living systems. The topics include chemistry, structure, specific roles of carbohydrates, lipids, amino acids, proteins and nucleic acids. General characteristics and properties of enzymes including enzyme kinetics will also be covered.

**Course Objectives**

* To provide a background for further study in biological sciences and advance biochemistry course.
* To develop an understanding of names, structure and function of biological molecules.
* To gain basic understanding of enzyme kinetics.
* To develop skills to carry out analyses and basic calculations relating to solutions, energy and catalysis.
* To develop an appreciation of the role of biochemistry in our daily life.
* To gain an understanding of current status of research in relevant area.

**Learning Outcomes**

Upon the successful completion of this course a student should be able to:

* Have command on the technical language used to communicate biochemistry information.
* Explain the composition, structure and function of complex biological molecules.
* Explain the core concepts of biochemistry and the universality of the processes in living organisms.
* Have a good handle on basic biochemistry laboratory techniques
* Demonstrate scientific write-up work in the form of short laboratory report.
* Integrate the knowledge learned in general education and its relevance to the student’s life and career

**Text**

1- Lehninger Principles of Biochemistry. David L. Nelson & Michael M. Cox. Sixth edition.

W. H. Freeman Publisher. 2013.

2- Donald Voet and Judith Voet. Biochemistry. John Wiley and Sons. 4th Ed.

**Course Policies**

**Attendance**: students must attend all class meetings to assure the best possible grades; failure to do so will drastically affect the grade. **If a student fails to attend 80% of the lectures & 80% of labs s(he) will not be allowed to appear in the Mid and/or Final Examinations.** The weight-age of the attendance will be 5 % of the grade.

**Exams**: There will be two lecture exams and one lab exams during the term. The first lecture exam (mid-term) will be of one-hour duration and the final exam will be of two-hour duration. The midterm exam will constitute 20% and the final will constitute 30% of the grade. The format of the exams will be both objective and descriptive type (limited choice will be given in the descriptive questions). The lab exam will be of 20% weightage and will be given during the last week of the semester.

**Quizzes:** There will be four quizzes given during the semester and best THREE will constitute 15% of the grades. If a student do not appear in the quiz s(he) will be awarded zero point. No makeup quiz will be given.

**Assignments/report:** Students are required to write one assignment. The weight-age of the assignment will be 10% of the grade.

**Missed Exam:** Students must take all the exams. If a student misses an exam for any invalid reason (s)he will receive zero score. Make up-exam will only be given on account of an emergency.

**Cheating and Plagiarism:** There will be no tolerance for cheating/plagiarism. Any student caught cheating on the exam will be reported to the Academic Integrity Committee. Detailed policy of classroom misconduct, cheating and plagiarism given in the Student Handbook will be strictly followed. Students are responsible for these directions given about dishonesty and plagiarism.

**Classroom Rules:** Students are not allowed to bring food and beverages in the class. Use of mobile phone in the class is strictly prohibited. Students are advised to silence their mobiles before coming to class. Failure to do so will lead to disciplinary action.

Weight-age and Grading:

**Activity weight age**

Midterm exam 20 %

Final exam 30 %

Lab exam 20 %

Quizzes 15 %

Assignment 10 %

Attendance 5 %

100

A 4.00 93 – 100% C 2.00 73 – 76%

A- 3.70 90 – 92% C- 1.70 70 – 72%

B+ 3.30 87 – 89% D+ 1.30 67 – 69%

B 3.00 83- -86% D 1.00 60 – 66%

B- 2.70 80 – 82 % F 0.00 59 or below

C+ 2.30 77 –79% Failing

**Course Outline**

**Week Topic Laboratory**

1 course overview Lab overview, safety

2 Carbohydrates Biochemical calculations

3 Carbohydrates Quantitative analysis of sugars

4 Carbohydrates Rf value of sugars

5 Lipids Quantitative analysis of fats

6 Lipids Saponification of fats

7 Amino acids, Proteins Rf value of amino acids

8 Proteins Quantitative analysis of proteins

9 Proteins Enzyme assay

10 Proteins Enzyme assay

11 Enzymes Enzyme assay data analysis

12 Enzymes DNA extraction

13 Enzymes DNA electrophoresis

14 Nucleic acids Protein electrophoresis

15 Nucleic acids Protein electrophoresis

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| **Topic** | **Book** | **Chapter** |
| Introduction  Thermodynamics  Water | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch1: Foundations of biochemistry  Ch2: Water |
| Biochemistry (Voet and Voet) | Ch1: Life  Ch2: Aquous solutions  Ch3: Thermodynamics principles |
| Carbohydrates | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch7: Carbohydrates and glycobiology |
| Biochemistry (Voet and Voet) | Ch11: Sugars and polysaccharides |
| Lipids | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch10: Lipids  Ch 11: Biological membranes and Transport |
| Biochemistry (Voet and Voet) | Ch12: Lipids and membranes |
| Amino acids | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch3: Amino acids, peptides and proteins |
| Biochemistry (Voet and Voet) | Ch4: Amino acids |
| Proteins | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch:4 Three dimensional structure of proteins |
| Biochemistry (Voet and Voet) | Ch7: Covalent structure of proteins and nucleic acids  Ch:8 Three dimensional structure of proteins |
| Enzymes | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch6: Enzymes |
| Biochemistry (Voet and Voet) | Ch:13 Introduction to enzymes  Ch14: Rates of enzymatic reactions |
| Nucleic acids | Lehninger Principles of Biochemistry (Nelson and Cox) | Ch8: Nucleotides and nucleic acids |
| Biochemistry (Voet and Voet) | Ch29: Nucleic acid structure |

**Quiz**

There will be four quizzes given during the semester and best THREE will constitute 15% of the grades. If a student do not appear in the quiz s(he) will be awarded zero point. No makeup quiz will be given.

The quiz will contain 10 multiple choice questions - each of 1 point. Maximum time given is 10 minutes.

Each questions starts with a statement and is followed by four choices. You are required to ENCIRCLE the most suitable option of each question. No credit will be given for cutting/over writing/ multiple answers.

Sample questions:

1: What would be the least likely consequence if membranes would be completely permeable to polar substances?

A: Water molecules could pass through the membrane freely

B: Polar molecules could pass through the membrane freely

C: Non-polar molecules could pass through the membrane freely

D: Cells would be able to maintain high concentration of polar solutes inside them

*Ans: ‘D’ if membrane would be permeable to polar substances, the polar solutes will diffuse out of the cell and hence no concentration gradient could be established.*

**Midterm Exam**

This exam is of one hour duration and carries 40 marks. The exam consists of two sections.

**Section I**: There will be 20 multiple choice questions (MCQs) in this section (each of one mark). Each question starts with a statement and is followed by four choices. Read the statement carefully and ENCIRCLE the most suitable choice for each question. CUTTING /OVERWRIING IS NOT ALLOWED. No credit will be given for cutting/over-writing. Total points for this section are 20.

This section should be solved on the question paper. Maximum time given for this section is 30 minutes. This section will be collected after 30 minutes and you will be given section II. If you finish section I before 30 minutes, you can return it and can proceed to section II. Rest of the time will be for section II.

**Section II**: In this section there will be short-answer questions (each of five marks). You are required to attempt ANY 4 out of 5 questions given. Total points for this section will be 20.

**Section I** (1 point each) Encircle the most suitable answer for each question. No credit will be given for cutting/over-writing.

1: Maltose CANNOT be formed by the hydrolysis of

A: Dextrins

B: Starch

C: Cellulose

D: Glycogen

*Ans is “C” i.e. cellulose. Maltose is a diasaccharide with alpha 1-4 glycosidic linkage between two glucose monomers. All carbohydrates described above have alpha 1-4 glycosidic linkage in them except cellulose (which contains beta 1-4 glycosidic linkage). So it cannot be hydrolyzed to maltose.*

2: Which of the following monosaccharides is NOT an aldose?

A: Erythrose

B: Fructose

C: Glucose

D: Glyceraldehyde

E: Ribose

*Ans: B. Fructose is a ketose*

**Section II** (5 points each)

**Q1 A:** How alpha-D glucose can be converted into beta-D-glucose? (3 points)

**Q1 B:** How the presence of a relatively less polar solvent, when mixed with water, will affect the solubility of hydrophilic biomolecules? (2 points)

**Q2 A:** What are lipids and why are they not soluble in water? What is the difference between saturated and an unsaturated fat? (1+1)

**Q2 B:** Write the structure of the following fatty acids: C18:2 (9, 12) and C16:0 (1.5+1.5)

**Final Exam**

This exam is of two hours duration and carries 60 marks. The exam consists of two sections.

**Section I**: There will be 30 multiple choice questions (MCQs) in this section (each of one mark). Each question starts with a statement and is followed by four choices. Read the statement carefully and ENCIRCLE the most suitable choice for each question. CUTTING /OVERWRIING IS NOT ALLOWED. Total points for this section are 30. This section should be solved on the question paper. Maximum time given for this section will be 60 minutes. After this time, this section will be collected. If a student finishes section I before 60 minutes, he/she can return it and can proceed to section II.

**Section II**: In this section there will contain descriptive questions (each of ten marks). You are required to attempt ANY 3 out of 5 questions given. Total points for this section will be 30.

**Lab Exam**

The lab exam will be of total 20 points. You will be assigned an experiment. Writing material, principle and method of the assigned experiment will carry 10 points, performance 5 points and lab notebook 5 points.

Written part will be of 10 points. You will be required to write the materials (2 point) principle (4 points) and method (4 points) for the assigned experiment.

In addition, you will be required to perform the same assigned experiment (3 points for performance, 2 points for result/observation). You will be given a time of 15 minutes to perform the experiment. **You must show your reading/observation to the examiner, record on your answer book and get it signed.**

Lab notebook will carry 5 points