

SUL ROSS STATE UNIVERSITY
Syllabus for Biochemistry I-21823
CHEM 4301_001 (Spring 2023)
(Alpine Campus)

Biochemistry I: Lecture
Room: WSB 307
Time: T/TR 9:30 am -10:45 am

Instructor: Dr. Hong Young Chang
Office: WSB 219
Email: hong.young.chang@sulross.edu
Office Hour: M-TR 2:00-6:30 pm

OBJECTIVES:

Student Learning Objectives (SLO):

A student graduating with a *chemistry major* is expected to demonstrate that (s)he is able to do the following:

1. Organic Chemistry—Students will be able to draw organic molecular structures and explain organic reactions, stereochemistry, structural analysis, and reactions in biological systems.
2. Inorganic Chemistry—The student will be able to demonstrate an understanding of coordination chemistry, valence theory, elementary actions, and advanced molecular theory.
3. Analytical Chemistry—The student will be able to demonstrate an understanding of the theory of analytical chemistry and conduct analytical analysis, including data analysis and calibration, equilibrium chemistry, gravimetric analysis, titrimetric analysis, and spectroscopic analysis, and electrochemical analysis.

4. Physical Chemistry—The student will be able to demonstrate an understanding of the application and theory of physical chemistry, including topics such as atomic structure, electrochemistry, surface chemistry, solid-state chemistry, and thermodynamics.

5. Research—The student will collect and analyze published chemical literature and undertake a chemistry research project.

BSc in Chemistry Marketable Skills:

1. Students will become good at punctuality and time management.
2. Students will analyze &/or synthesize molecules and perform spectroscopic characterization and interpret their results scientifically.
3. Students will become proficient at writing scientific papers and identifying appropriate references for the papers.
4. Students will become proficient at orally presenting scientific topics including the use of visual aids.

Biochemistry I Learning Objectives:

At the end of this course, a student should have a good understanding of:

1. Chemistry and biological functions of water, amino acids, and proteins
2. Enzyme reactions, kinetics, and inhibition
3. The structure and biological function of carbohydrates and lipids
4. Biological membranes and cellular transport
5. Storage and transfer of biological information (DNA replication/transcription and RNA translation)
6. SciFinder (Chemical Database), RCSB PDB bank, and the Protein Data Bank (NCBI)

Required Text Book:

“Concepts in Biochemistry” by Rodney Boyer, 2006, (3rd Edition), John Wiley & Sons, INC.

The SRSU library has one copy of this textbook in the “Textbook Collection” section. Please ask the library front desk if you need help finding this textbook.

Optional Reading:

“Lehninger Principles of Biochemistry” 6th Edition, David L. Nelson & Michael M. Cox, 2013, W.H. Freeman and Company, New York.

SRSU Library Services: The Sul Ross Library offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library’s website, library.sulross.edu. Off-campus access requires your LoboID and password. Check out materials using your photo ID. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or by phone (432-837-8123).

PyMOL is a free and open-source molecular graphics system for visualization, animation, editing, and publication-quality imagery on biomolecules. PyMOL is scriptable and can be extended using the Python language. Supports Windows, Mac OSX, Unix, and Linux. You can download PyMOL from the following website: [PyMOL | pymol.org](http://pymol.org)

The following chapters will be covered from “Concepts in Biochemistry”, 2006, (3rd Edition):

Chapter 1: Biochemistry: from atoms to molecules to cells

Chapter 2: Biomolecules in water

Chapter 3: Amino acids, Peptides, and Proteins

Chapter 4: Protein Architecture and Biological Function

Chapter 5: Enzymes I: Reactions, Kinetics, and Inhibition

Chapter 6: Enzymes II: Coenzymes, Regulation, Abzymes, and Ribozymes

Chapter 7: Carbohydrates: Structure and Biological Function

Chapter 8: Lipids: Structure and Biological Function

Chapter 10 & 11: DNA and RNA: Structure and Function, DNA Replication and Transcription

ATTENDANCE PREREQUISITE: BEING ABSENT FROM MORE THAN 9 LECTURES WILL RESULT IN FAILING THE COURSE.

Cell phones **ARE NOT** permitted for use in exams and should be turned off during class time.

Homework: Ten (10) homework will be assigned throughout the semester. All of the homework will contribute 20% of your final mark. Homework must be completed in PEN! You need to keep the due day.

EXAMINATIONS: There will be three in-course examinations and a final examination. **NO MAKEUP EXAMS WILL BE GIVEN.** The final is mandatory and will be comprehensive.

PERCENTAGE BREAKDOWN OF MARKS:

Homework: 20%

Each Midterm Exam (20%): 60%

Final Exam: 20%

Midterm Exam I: Tuesday, February 21st

Midterm Exam II: Tuesday, March 28th

Midterm Exam III: Tuesday, April 25th

Final Exam: Monday, May 15th, 8:00 am -10:00 am at WSB 307

SRSU Disability Services: ADA (Americans with Disabilities Act):

Sul Ross State University (SRSU) is committed to equal access in compliance with Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. Students seeking accessibility/accommodations services must contact Rebecca Greathouse Wren, LPC-S, SRSU's Accessibility Services Coordinator at 432-837-8203 (please leave a message and we'll get back to you as soon as we can during working hours), or email rebecca.wren@sulross.edu. Their office is located on the first floor of Ferguson Hall (Room 112), and our mailing address is P.O. Box C-122, Sul Ross State University, Alpine, Texas, 79832.

Scholastic Dishonesty:

*Students who violate the University rules on scholastic dishonesty are subject to penalties, including the possibility of an **F** in the course and/or dismissal from the University.*

Course Calendar

* This course calendar could be changed. Before one week, your professor will let you know the changes.

Date	Lecture #	Chapter #	Topics	Due work
Jan. 19	Lecture 1	Ch 1	Discussion on Syllabus, importance, and historic background of biochemistry, All living matter contains C, H, O, N, P, and S, Chemical elements in biomolecules, Combining elements into compounds, Biological Macromolecules, Cellular reactions, Organelles, Cells, Viruses, living cells (eukaryotes, prokaryotes, archaeobacteria archaea) Biochemistry comes in all sizes (S, M, L, and XL)	

Jan.24	Lecture 2		Storage and transfer of biological information- a preview Biological information, Genome, The DNA molecule, DNA -->DNA, DNA-->RNA, mRNA-->Proteins, The Genetic Code, DNA mutations	
Jan. 26	Lecture 3	Ch 2	Revision of Chapter 1 The biological roles of water, Noncovalent interactions in biomolecules Examples of non-covalent interactions; Hydrogen bonds, VDW, and Ionic bonds Characteristics of noncovalent interactions, Structure of water, Physical properties of water, Hydrophobic/amphiphilic, micelles polar compounds	Ch1 HW due
Jan.31	Lecture 4		Ionization of water, Equilibrium constant (K_{eq}), $pH = -\log[H^+]$, pK , conjugate acid-base pairs, acid dissociation constant, titration, titration curves for monoprotic acids and polyprotic acids, Henderson-Hasselbalch equation, Water solubility of molecules, Buffer systems to maintain a constant pH	
Feb. 2	Lecture 5	Ch 3	Revision of Chapter 2 Proteomics, The amino acids in proteins, Properties of alpha-amino acids	Ch2 HW due
Feb.7	Lecture 6		Ionic forms of amino acids, Zwitteric ions, pK values of the 20 amino acids from the alpha-carboxyl group and the alpha-amino group Stereochemistry (chiral center), enantiomers, optical activity	
Feb.9	Lecture 7		pK_1 values for the alpha-carboxyl groups pK_2 values for the alpha-amino groups pK_R values to ionizable groups Calculation of isoelectric pH (pH_i)	
Feb. 14	Lecture 8		Classification of amino acids (Group I, II, & III) Reactivity and analysis of amino acids by chromatographic methods Polypeptide and proteins; condensation, residues, amino terminus, Peptidases, Classes of proteins based on their biological functions: Enzymes, Structural proteins, Immune proteins, Transport and Storage proteins, Regulatory and Receptor Peptide bond formation and protein synthesis	

Feb.16	Lecture 9	Review & Test	Exam 1 Revision	
Feb.21	Lecture 10		Exam I day (it covers ch 1 & 2)	
Feb.23	Lecture 11	Ch 3	Determination of primary structure: Edman method of protein sequencing Importance of protein sequence data General principles of protein design Elements of secondary structure; alpha-helix, beta-sheets, bends, and loops, Super secondary structure, fibrous structure	
Feb.28	Lecture 12	Ch 4	Tertiary structure, Protein folding process, Protein unfolding Quaternary structure: Monomeric and Oligomeric proteins Protein structure and biological function	Ch 3 HW due
Mar.2	Lecture 13		Hemoglobin, alpha-keratin, Bacterial and Bovine Rhodopsin Revision on Chapter 4	
Mar.7	Lecture 14	Ch 5	Catalytic properties of the enzyme Enzymes, cofactors, and naming of enzymes Kinetic properties of enzymes (Michaelis-Menten equation), Kinetic constant K_M , V_{max} , and k_3 Characteristics of enzyme reactions	
Mar.9	Lecture 15		Enzyme active sites, substrate binding, and enzyme action Enzyme inhibition (Reversible & irreversible, Competitive, Noncompetitive, Uncompetitive)	Ch 4 HW due
Mar.21	Lecture 16	Ch 6	Revision on Chapter 5 Coenzymes, Vitamins, Metals as Nutrients, Allosteric enzymes Cellular regulation of enzymes	
Mar.23	Lecture 17	Review & Test	Exam 2 Revision	Ch 5 HW due
Mar.28	Lecture 18		Exam II day (it covers Ch 3, 4, & 5)	
Mar.30	Lecture 19	Ch 6	Design of new enzymes: Site-directed mutagenesis, Abzymes, Ribozymes Revision of Chapter 6	
Apr.4	Lecture 20	Ch 7	Monosaccharide (Aldose & Ketose) Carbohydrates in cyclic structures Reactions of monosaccharides	Ch 6 HW due

Apr.6	Lecture 21		Structural /Storage Polysaccharides, Peptidoglycans Glycoprotein structure and function Revision of Chapter 7	
Apr.11	Lecture 22	Ch 8	Fatty acid structure, Triacylglycerols, Glycerophospholipids, Sphingolipids, Steroids etc.	Ch 7 HW due
Apr.13	Lecture 23		Terpenes, Eicosanoids, Lipid-soluble vitamins, Pheromones, Electron carriers Revision of Chapter 8	
Apr.18	Lecture 24	Ch 10	RNA and DNA chemical structures, Nucleic acids, components of nucleotides, DNA double helix, tRNA/rRNA, Nucleases, Ribonucleoprotein enzymes	Ch 8 HW due
Apr.20	Lecture 25	Review & Test	Revision of Exam3	
Apr.25	Lecture 26		Exam III day (it covers Ch 5, 6, 7, & 8)	
Apr.27	Lecture 27	Ch 11	Replication of DNA, Action of DNA polymerases, Okazaki fragments, Eukaryotic chromosomes, Telomeres	
May 2	Lecture 28			
May 4	Lecture 29	Review	Revision on Ch 1, 2, 3, 4 & 5	
May 9	Lecture 30	Review	Revision on Ch 6, 7, 8, 10, &11	
May 15	Lecture 31	Final Exam	Final Exam Day, Monday, 8:00AM to 10:00AM, WSB307	