湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Advanced Topics in Protein Biochemistry
Course Code	BIOC 4312
Semester	Summer 2025
Course Length	5 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite	BIOC 3161 Protein Structure and Function

Course Description:

This course explores advanced principles in protein biochemistry with a focus on the molecular basis of structure-function relationships in biologically important proteins. Students will examine how high-resolution structural data, derived from X-ray crystallography, cryo-electron microscopy, and computational models, reveal key insights into protein folding, enzymatic mechanisms, macromolecular complex formation, and genome interaction.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** – Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** – Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** – Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.
- **Global and Cultural Awareness** – Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Interpret and analyze protein and nucleic acid structures using structural biology tools;
- Explain the molecular mechanisms underlying DNA replication, transcription, translation, and enzymatic catalysis;
- Evaluate structure-function relationships in protein complexes and catalytic systems;
- Apply principles of rational protein design and directed evolution;
- Critically assess and communicate findings from primary structural biology literature.

Textbooks/Supplies/Materials/Equipment/ Technology or Technical Requirements:

Textbooks:

- *Biochemistry* 8th ed by Berg, Tymoczko & Stryer. Macmillan Learning, 2015. (abbreviated *BTS*)
- *How Proteins Work* by Mike Williamson. Garland Science, 2011. (abbreviated *HPW*)

Technical Requirements: Laptops with PyMOL or Chimera installed

Course Requirements:

Structural Biology Workshops

To support applied learning, four computational workshops are embedded in the course. These workshops train students in the visualization, interpretation, and analysis of biomolecular structures. They help prepare students for independent structural analysis in the final project.

Workshop Requirements:

- Attendance is mandatory. Students must bring laptops with PyMOL or Chimera installed.
- A short workshop summary (1–2 pages) is due one week after each session.
- Grading is based on completeness, structural insight, and clarity of explanation.

Reading Critiques

Students will submit structured critiques of assigned primary research articles throughout the term. These critiques will focus on the biological question, methods used, interpretation of structural data, and critical evaluation of the conclusions. Each critique should reflect thoughtful engagement with the paper and integration with course themes.

Problem Sets

A series of problem sets will be assigned throughout the course to reinforce conceptual understanding and applied skills. Problems may involve structural analysis from PDB files, short written explanations, pathway mapping, or drawing structure-based mechanisms. These assignments provide regular practice in applying course content to real molecular systems.

Exams

There will be one midterm and one final exam. The midterm will cover Lectures 1–12, while the final will be cumulative, with emphasis on the second half of the course. Exams will include interpretation of figures, analysis of protein structure-function

relationships, and mechanistic questions that test conceptual integration and critical thinking.

Research Project and Presentation
For the final capstone assignment, each student will select a biomolecular complex (e.g., protein-DNA, protein-RNA, or protein-protein) from the Protein Data Bank. Students will conduct a structural analysis, prepare a written report (5–7 pages), and deliver a 10-minute presentation. Evaluation will focus on the depth of analysis, clarity of interpretation, visual quality of structural figures, and integration of workshop techniques.

Assessments: Activity	**Percent Contribution**
Workshop Summaries (4)	10%
Reading Critiques	10%
Problem Sets	10%
Midterm Exam	15%
Final Exam	25%
Project Report	20%
Project Presentation	10%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	**Percentage of available points**
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

BIOC 4312 Schedule		
Lecture	Topic	Readings
L1	Introduction to Structural Biology	*BTS* CH. 1, 2
L2	Protein Architecture: Motifs and Domains	*BTS* CH. 2, 3
L3	Forces Stabilizing Protein Structure	*BTS* CH. 2, 3
L4	Protein Folding Pathways and Disorders	*BTS* CH. 2, 23
L5	Experimental Techniques I: X-ray Crystallography	*BTS* CH. 4
Workshop 1	Protein Visualization and Structural Navigation	*BTS* CH. 4
L6	Experimental Techniques II: Cryo-Electron Microscopy	*BTS* CH. 4

	*Reading Critique #1 due	
L7	Protein Dynamics and NMR Spectroscopy	*HPW* CH. 6
L8	Protein-Protein Interactions and Complexes	*BTS* CH. 3
L9	Structural Basis of DNA Replication (T7 Polymerase)	*BTS* CH. 28
L10	Transcription Mechanisms and RNA Polymerase II	*BTS* CH. 29
L11	DNA Topology and Topoisomerases	*BTS* CH. 28
Workshop 2	Structure-Function Comparison: Wild-Type vs. Mutant Proteins	*HPW* CH. 2, 4
L12	Ribosome Structure and Translation	*BTS* CH. 30
	*Reading Critique #2 due	
/	**Midterm Exam**	/
L13	DNA Recognition: Helix-Turn-Helix, Zinc Fingers, TALEs	*BTS* CH. 31
L14	Modular DNA Targeting and Genome Engineering	*BTS* CH. 29, 31
L15	CRISPR-Cas9 Structure and Function	*BTS* CH. 29, 31
L16	Chromatin Architecture and Nucleosomes	*BTS* CH. 28, 31
L17	Signal Transduction and Structural Regulation	*BTS* CH. 14
	*Reading Critique #3 due	
Workshop 3	Functional Site Annotation and Catalytic Mechanisms	*HPW* CH. 5, 9
L18	Membrane Proteins and Transporters	*HPW* CH. 12-13
L19	Structural Enzymology I: Catalysis and Active Sites	*HPW* CH. 5
L20	Structural Enzymology II: Fidelity and Proofreading	*HPW* CH. 5
L21	Rational Protein Design: Kemp Eliminase	*BTS* CH.6, 32
	*Report Submission	
Workshop 4	Protein Design and Mutagenesis Simulation	*BTS* CH.6, 32
L22	Directed Evolution and Enzyme Optimization	*BTS* CH.6, 32
L23	Interpreting Protein Structures from PDB Files	*HPW* CH. 11
L24	Critical Reading of Structural Biology Literature	handouts
	*Reading Critique #4 due	
L25	*Final Presentations & Course Integration	/
/	**Final Exam**	/

Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention, as he/she is not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations
All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates
All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work
The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities
Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.