SYLLABUS

Biol.4890/5890 Practical Protein Crystallography – Spring 2017

Lectures: T 12:30-2:10 PM; Location Olsen Hall (tba)
Labs: R 12:30-4:20 PM; Location Olsen Hall 509, or Olsen Computer Lab 610
Office Hours: by appointment (HwaiChen_Guo@uml.edu)

Instructors:

Prof. Hwai-Chen Guo; Olsen 413B, ext. 4-2878, HwaiChen_Guo@uml.edu
TA: Suchita Pande; Olsen 508, ext. 4-5072, Suchita_Pande@student.uml.edu

Course Prerequisites:
Experimental Methods in Biology (Biol.2330L) or equivalent
OR Biochemistry Techniques (Biol.4210L/5210L) or equivalent

Course Materials:
Required Text: None.
Handouts for the entire semester are provided in this booklet.
Lab procedures are distributed in a separate handout. These procedures should be read by each student prior to coming to each laboratory session.
Calculator – You will need a calculator that is capable of doing simple calculations.
Other: A bound laboratory notebook needs to be purchased by the students.

Course Description:
This course provides grounding in the principles and practice of protein x-ray crystallography. As the importance of proteins continues to grow, more and more researchers have found a working knowledge of protein crystallography to be an indispensable tool in fields ranging from basic biological sciences to pharmaceutical and biotechnology industries. The course will be unique in format and provide both didactic and laboratory instruction. It is comprised of a series of lecture and laboratory exercises, with an emphasis on practical techniques and hands-on experience of modern protein crystallography. The course will cover the fundamental knowledge about x-ray physics, instrumentation and geometrical diffraction, protein crystallization, macromolecular data collection and processing, phase estimation and improvement, model building and refinement, and model assessment.

Learning Objectives:
1. Develop a basic knowledge about determining crystal structure.
2. Identify major steps in protein crystallography.
3. Gain a hands-on experience of protein crystallization.
4. Obtain a working knowledge of macromolecular data collection.
5. Gain an appreciation for the crystallographic phase problem.
6. Demonstrate an understand of model building and refinement.
7. Read critically to evaluate scientific publications with crystal structures.
8. Learn to keep clear, accurate and complete laboratory research notebooks.

Grading Policies:

Students will be graded on the evaluation of the two 75-minute exams, the final take-home exam/report, weekly lab reports, and a combination of class participation, attendance, and overall attitude toward the course.

Examinations

Students will be examined through two mechanisms:

1. Two 75-minute essay style written examinations designed to test the students' knowledge of individual aspects of protein crystallography. The exams will have open-response questions, and may require students to utilize the information from class to design experiments to address problems, or to interpret hypothetical experimental data. These examinations will constitute thirty percent (30%) of the final grade.
2. A written term paper (take-home final exam) based on a detailed publication in the recent literature. The publication will be chosen by the student in consultation with the course instructor and contain significant discussion and use of protein crystallography. Students need to carefully choose their papers, and are advised to seek the input of the instructor by mid-semester as to the appropriateness of a chosen paper. It must be a primary research article or letter from the journals *Cell, Nature, Science, Nature Structural Biology, or Structure* that greatly interests you, and is published within the past 18 months. In the written term paper the student will be expected to include a research review on that topic, analyze, present the required theoretical and experimental approach, and criticize the results obtained within the context of limitations in the methods, as well as to assess qualities of the reported crystal structure(s). The report will be evaluated based on the relevance and difficulty of the chosen paper as well as the thoroughness of the discussion. This report will constitute twenty percent (20%) of the final grade.

For students taking the undergraduate credit (Biol.4890)

Students will be evaluated as for graduate students, except with an option of dropping one lab report grade before the postlab grade is calculated.

Grading Weights:	Undergraduates	Graduates
Exam I	15%	15%
Exam II	15%	15%
Final Exam/Report	20%	20%
Weekly PostLab Reports	40% (allow 1 dropped)	40%
Participation	10%	10%

Course Rules:

The Course Syllabus and the Course Rules are subject to change throughout the semester at the discretion of the instructor. Timely notice will be given regarding any changes, either in class, by e-mail, and/or on the website http://faculty.uml.edu/hwaichen_guo/Teaching/Teaching.aspx

As in any classroom or research laboratory setting, standards of common courtesy and behavior are expected. Included among these are the following:

In Class/Lab:

Be punctual and turn off mobile communication devices
No cell phones, iPod, IM, nor chatting
No food or beverages are allowed
Plan, in advance, to remain in the lecture/lab for the duration of the class time
Be respectful of the instructor and other students, ask questions but no chatting
Attire during lab- closed-toes shoes are mandatory
Clothing must fully cover your arms and legs
Leave equipment clean and in good condition
Return items to their appropriate location so they can easily be found by the next people who need to use them.

Exams:

Closed book for exams I & II; Open book/take-home for the final exam/report
No make-up exams

Attendance:

Because this is a practical laboratory course, attendance and execution of the experiments are compulsory. Labs cannot be made up. If you miss a lab and have appropriate documentation indicating a valid reason for missing lab, you will be excused from that lab. If you do not have documentation indicating a valid reason for missing lab, you will be given a zero for that postlab report. You cannot use your partner's or anyone else's data to submit a postlab report for a lab you missed.

Format of PostLab Reports:

The post-lab reports for labs must be typewritten and turned in **on the following week right before the next laboratory starts**. There will be a receptacle box on a table, just inside room 509 for the post-labs at the beginning of each lab. The box will be removed 10 minutes following the start of the lab and the post-labs removed for grading. Turning in the lab reports after this time will not be permitted. One formal post-lab report will be prepared using the laboratory data in your lab notebook, and should cover lab objectives, importance, methods, calculations, results and discussions. Quality of work will be assessed based on results obtained, a proper recording of raw data onto the lab notebook, and the thoroughness of the discussion.

Academic Honesty:

Cheating or plagiarism on any exam or report will not be tolerated, and will receive an "F" for the course
Any student caught cheating or helping another student cheat will earn zero for that assignment. For more information see: https://www.uml.edu/Catalog/Undergraduate/Policies/Academic-Policies/Academic-Integrity.aspx

Lecture Schedule:

Dates	Subject	Topics
January 17 T	Course Intro, X-Ray Physics	1
24 T	Geometrical Diffraction	2
31 T	Protein Purification and Crystallization	3
February 7 T	Symmetry	4
14 T	Crystal Storage and Handling	5
21 T	No Class, Monday Class Schedule	
28 T	Exam I (topics 1-5)	
March 7 T	Instrumentation and Data Collection	6
14 T	No Class, Spring Recess	
21 T	Data Collection Strategies and Processing	7
28 T	The Phase Problem, Phase Estimation	8
April 4 T	Phase Improvement & Map Calculation	9
11 T	Model Building and Structure Refinement	10
18 T	Exam II (topics 6-10)	
25 T	Structure Assessment and Crtique Structure Paper	11
May 1 M	Final Exam due (take-home exam/report)	

Lab Schedule:

Dates	Subject	Labs
January 26 R	stock solutions for crystallization and gel	1
February 2 R	protein quantification (spec methods)	2
9 R	protein purity & quantity assessment (PAGE)	3
16 R	initial crystallization	4
23 R	No Lab, Presidents Day – partial/permuted week	
March 2 R	crystallization optimization	5
9 R	crystal handling and storage	6
16 R	No Lab, Spring Recess	
23 R	data collection (Olney OG-6)	7
30 R	data processing (Olsen 610)	8
April 6 R	molecular replacement and map calculation (Olsen 610)	9
13 R	model building (Olsen 610)	10
20 R	structure refinement and model refitting (Olsen 610)	11
27 R	Final Lab Report due; lab make-up if necessary	