

## 2022 Experimental Molecular Biophysics

Time: Tuesdays 14:00-17:00

Place: R208 of the Institute of Biological Chemistry, Academia Sinica

Credit: 3 credits

Coordinator: Dr. Wei-Yuan Yang

Instructors: Dr. Joseph Jen-Tse Huang (IoC), Dr. Su-Chang Lin (GRC), Dr. Wei-Yuan Yang (IBC),  
Dr. Hsin-Yung Yen (IBC)

TA: Kareem Isaac Daniels

### Perspective:

A holy grail in biology is to modulate the functions of bio-molecules. For example, one wants to design small compounds to perturb the form and activities of bio-molecules for disease intervention (*e.g.*, inhibition of protein aggregation for treating neurodegenerative diseases). These pursuits will not be possible without proper knowledge (*e.g.*, structure, function, composition, interactome, localization) of the bio-molecules at hand. This course will give you a first-hand look at the many biophysical techniques that allow you to characterize your biomolecule of interest through lectures, facility visits, hands-on sessions, and designed presentations.

### Grading scheme:

25% for each module

- ◆ Topic A Spectroscopy and Solution Biophysics
  - ◆ Class participation: 10%
  - ◆ Presentation: 15%
- ◆ Topic B Imaging
  - ◆ Class participation: 15%
  - ◆ In-class quiz: 5%
  - ◆ Presentation: 5%
- ◆ Topic C Crystallography
  - ◆ Accomplishments in hands-on training: 20%
  - ◆ Responding to teacher's questions: 5%
- ◆ Topic D Mass Spec
  - ◆ Class participation: 10%
  - ◆ Hands-on: 5%
  - ◆ Presentation: 10%

\*Asking questions for bonus points

### Attendance:

- ◆ Late: **-1** of the final grade (attend after 14:00 will be considered late)
- ◆ Absence: **-3** pts of final grade (did not contact the TAs or the program secretary before class)
- ◆ Absence without supporting document: **-1** of the final grade

## Schedule

Date	<p><b>Topic A: Spectroscopy and Solution Biophysics</b></p> <p>This module is to lecture on general spectroscopy techniques for peptides, proteins, and protein-protein interactions. The techniques to be covered include fluorescence, circular dichroism, infrared spectroscopy, fluorescence life-time imaging ...etc. Topics on protein misfolding and therapeutic strategies against protein misfolding will be introduced.</p>	Instructor
2/15	<p><b>A1: Principle of spectroscopy and protein misfolding</b> (peptide synthesis, CD, fluorescence, and infrared spectroscopy)</p>	Dr. Joseph Jen-Tse Huang
2/22	<p><b>A2: Therapeutic strategies against protein misfolding</b> (nanoparticle preparation, fluorescence life-time imaging, Fluorescence recovery after photobleaching)</p>	
3/1	<p><b>A3: Hands-on experiments</b> (peptide synthesis, CD, fluorescence imaging)</p>	
3/8	<p><b>A4: Student Presentation</b> (present related studies on protein misfolding or therapeutic strategy against protein misfolding diseases)</p>	
Date	<p><b>Topic B: Imaging</b></p> <p>This module will take you into the world of bio-imaging. We will help develop your intuition on bio-imaging, show you what microscopes there are on campus, and go through various imaging tricks that can help advance your research.</p>	Instructor
3/15	<p><b>B1: Fun facts of imaging: distribution, resolution, and contrast mechanisms</b></p>	Dr. Wei Yuan Yang
3/22	<p><b>B2: The many types of fluorescence microscopes</b> (Hands-on session: using a confocal microscope)</p>	
3/29	<p><b>B3: Inside image quantification</b> (Hands-on session: playing with ImageJ. //personal laptop required)</p>	
4/12	<p><b>B4: Case study: spatial genomics- transcriptomics through imaging</b> (short student presentations)</p>	

Date	<b>Topic C: Crystallography</b> This module is to lecture on the techniques for single-crystal X-ray diffraction and its applications and limitations. We will also use lysozyme as a model protein to go through the steps of protein crystallization, X-ray data collection and analysis	Instructor
4/19	<b>C1: Protein crystallization</b> Hands-on training: Hanging-drop protein crystallization	Dr. Su-Chang Lin
4/26	<b>C2: Why X-ray crystallography?</b> Hands-on training: Crystal mounting	
5/3	<b>C3: Principle of X-ray diffraction</b> Hands-on training: X-ray diffraction	
5/10	<b>C4: Data analysis</b> Hands-on training: Data analysis	
Date	<b>Topic D: Mass Spec</b> The goal of this module is to introduce the principle of mass spectrometry (MS) and the progress made in technological development. The application of MS for a range of biology/pharmaceutics studies and its emerging utility in investigating protein structures and dynamics will be further discussed.	Instructor
5/17	<b>D1: History and basis of mass spectrometry</b>	Dr. Hsin-Yung Yen
5/24	<b>D2: The application of mass spectrometry in “mocs” studies</b> Hands-on session: Instrumentation and data analysis)	
5/31	<b>D3: State-of-the-art mass spectrometry in investigating structural and dynamical property of protein molecules</b>	
6/7	<b>D4: Student presentation/Special talk</b>	