CHEM 521 (2 unit): Basic Principles of Physical Methods in Biochemistry
Fall 2020

Syllabus

Overview

This course is designed to teach principles underlying physical analytical methods commonly utilized in detecting and quantifying biological macromolecules as well as in analyzing their structure and function. Specifically, the course will use analyses of non-covalent binding as the central theme, and will cover two main topics: (i) Basic Thermodynamics; and (ii) Optical Spectroscopy. In addition to lectures and class discussions on these principles, the class will include quantitative simulation/fitting of binding data and case studies on current literature. ..Target audiences are first and second year graduate students. On completion of the course, students are expected to gain understanding of physical methods for future use in their research.

Lecturer: Professor Peter Z. Qin
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Class Web Page: materials will be posted at the class web site at Blackboard
You are responsible for regularly visiting the web page for new information on the course.

Location: On-Line via Zoom/Blackboard

Time: 9:30-10:50am; Thursdays; see Schedule for details
Note: Sept. 4 is the last day to drop this course without a mark of W.

Office Hours: W 12 – 1 or by appointment

Notes & References:

- Course Reader (post lecture notes, papers, syllabus, *etc*…)
- Tinoco, et. al.; *Physical Chemistry, Principles and Applications in Biological Sciences*; Prentice Hall, 5th Edition (2013)
- Eisenberg & Crothers; *Physical Chemistry, with Applications to the Life Sciences*; Benjamin/Cummings, (1979)
- Atkins & de Paula, *Physical Chemistry for the Life Sciences*; W.H. Freeman & Co. 2nd Edition (2011)

Grading:

Discussion/Homework:	40%
Exam 1 (open book):	30%
Exam 2 (open book):	30%

Note: No makeup exams will be given

Statement on Academic Integrity: USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as

well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus (https://policy.usc.edu/scampus/), the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A. Should there be any suspicion of academic dishonesty and violation of stated policy, students will be referred to the Office of Student Judicial Affairs and Community Standards (https://sjacs.usc.edu/) for review and discipline.

It is the student's ethical responsibility as emerging professionals to appropriately use and handle Zoom recordings, asynchronous recordings, or other academic materials and to keep personal information shared in class private. Students are not permitted to create their own class recordings without the instructor's permission. Violations of these policies will be met with the appropriate disciplinary sanction. As stated under the existing SCampus policies regarding class notes (https://policy.usc.edu/scampus-part-c/):

> "Notes or recordings made by students based on a university class or lecture may only be made for purposes of individual or group study, or for other usual non-commercial purposes that reasonably arise from the student's membership in the class or attendance at the university. This restriction also applies to any information distributed, disseminated or in any way displayed for use in relationship to the class, whether obtained in class, via email or otherwise on the internet, or via any other medium. Actions in violation of this policy constitute a violation of the Student Conduct Code, and may subject an individual or entity to university discipline and/or legal proceedings."

Schedule (subject to change)

Week	Date	Topic
1	Aug. 20	• Class introduction; • General framework for analyzing binding • Basic principles for analyzing binding: (*) State Functions; (*) Paths (Mechanisms); (*) Thermodynamics vs. Kinetics
2	Aug. 27	• Basic principles for analyzing binding: (*) 2nd Law & Direction of Spontaneity; (*) Free Energy & Equilibrium Constants • Analyzing Binding: (*) ICE table (*) Numerical simulation (w/ Excel) (*) Fitting binding curves (w/ Matlab)
3	Sept. 3	• Binding measurements (in bulk): Gel-Shift & ITC
4	Sept. 10	• Dynamic perspective of equilibrium binding; (*) equilibrium constants and on/off-rates (*) binding measurements (in bulk): BioCore
5	Sept. 17	• Basic theory: EM wave; light/mater interaction;
6	Sept. 24	***Exam 1*** (lecture content from wk 1-4)
7	Oct. 1	• Absorption; Circular Dichroism Spectroscopy; • Light Scattering
8	Oct. 8	• Fluorescence spectroscopy; FRET
9	Oct. 15	Virtual Tour: NanoBiophysics Core
10	Oct. 22	• FRET; Single Molecule Measurements
11	Oct. 29	• Case Study: DNA recognition by CRISPR-Cas9
12	Nov. 5	• Case Study: DNA recognition by CRISPR-Cas9
13	Nov. 12	***Exam 2***