

# Physical Methods in Biochemistry

Fall 2011

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

BIOC 522 (2 unit): Applications of Physical Methods in Biochemistry

[http://pzqin.usc.edu/PhysMth\\_Cls/](http://pzqin.usc.edu/PhysMth_Cls/)

## Syllabus

### (1) Overview

This course is designed to teach the principles underlying physical analytical methods commonly utilized in research in biochemistry and molecular biology. These methods include detection, quantification, and characterization of biological macromolecules as well as their structural and functional analyses. Target audiences include first and second year graduate students. On completion of the course, students are expected to gain understanding of a broad range of physical methods that are essential for current state-of-art research in biochemistry and molecular biology.

The course will be presented as two closely inter-winded components. One component will focus on the basic principles on physical methods in biochemistry”, and will be offered by the Department of Chemistry (CHEM 521). The other component will focus on state-of-art applications of these methods, and will be offered by the Department of Biochemistry (BIOC 522). The classes will be offered on UPC and HSC campuses. *Students must register for both classes*. Whenever possible, videoconferencing will be used to minimize commute. Exceptions are laboratory demonstrations and exams.

Both CHEM 521 and BIOC 522 require D-clearance (i.e., department approval before registration). For registration and class information, please contact Prof. Peter Qin (213-821-2461, [pzq@usc.edu](mailto:pzq@usc.edu)) and Prof. Ralf Lagen (323-442-1323, [langen@usc.edu](mailto:langen@usc.edu)).

### (2) Class meeting time and locations\*

Lecture Time: Tuesdays, 1:30 – 2:50 pm  
Thursdays, 1:00 – 2:20 pm

Location: UPC: Ahmanson Center for Biological Research (ACB), Rm 238  
HSC: Zilkha Neurogenetic Institute (ZNI), Rm 112

\* Videoconferencing between UPC and HSC will be offered, with the exception of laboratory demonstrations and exams. However, you can always travel to the site of the live lecture, which is indicated on the schedule next to the name of the instructor. For information on trans services between UPC and HSC, check out <http://transnet.usc.edu/transit/routes.aspx>.

### (3) Course Coordinators

CHEM 521 Peter Qin 213-821-2461; [pzq@usc.edu](mailto:pzq@usc.edu)

BIOC 522 Ralf Lagen 323-442-1323; [langen@usc.edu](mailto:langen@usc.edu)

### (4) Instructors

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**(5) Topics covered** (see also the “schedule” section of the class web page)

- I. Optical Spectroscopy and Imaging Methods.
- II. Magnetic Resonance Methods.
- III. Macro-molecular Structures & Proteomics.
- IV. Characterization of Bio-molecule Interaction in Solution.

**(6) Suggest Reference Text Books**

Tinoco, Sauer and Wang, Physical Chemistry, Principles and Applications in Biological Sciences, Prentice Hall, 4th Edition (2001).

Cantor & Schimmel, Biophysical Chemistry, W.H. Freeman & Co. (1980).

van Holde, Johnson, and Ho, Principles of Physical Biochemistry, Prentice Hall, 1998.

Atkins & de Paula, Physical Chemistry for the Life Sciences, W.H. Freeman & Co. (2005)

**(7) Grading** The same grade will be assigned to CHEM 521 and BIOC 522, and will be determined based on:

Homework:	10%
Class presentation	10% (pass/fail)
Midterm exam:	40%
Final exam:	40%

**(8) 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, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/scampus/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

**Schedule** (subject to change)

<b>Week</b>	<b>Date</b>	<b>CHEM 521</b>	<b>Date</b>	<b>BIOC 522</b>
1	Aug. 23	Introduction to class; Review of basic concepts on electromagnetic radiation; Basic theory on interaction between light/mater  Instructor: Qin (UPC)	Aug. 25	Optical Absorption; Beers law; Applications to Bio-molecules  Instructor: Qin (UPC)
2	Aug. 30	Polarization of light; Circular Dichroism (CD) Spectroscopy; Applications of CD Instructor  Instructor: Hegde (HSC)	Sept. 1	Fluorescence spectroscopy and its applications  Instructor: Qin (UPC)
3	Sept. 6	Optical Imaging: Theory  Instructor: Chow (HSC)	Sept. 8	Optical Imaging: Applications  Instructor: Chow (HSC)
4	Sept. 13	Light scattering  Instructor: Qin (UPC)	Sept. 15	Introduction to EPR  Instructor: Langen (HSC)
5	Sept. 20	Site-directed spin labeling of proteins  Instructor: Langen (HSC)	Sept. 22	<i>Laboratory demonstration (UPC): light scattering, fluorescence, AFM, CD</i>
6	Sept. 27	<i>No Class</i>	Sept. 29	<b>Midterm (CHEM521 and BIOC522)</b>
7	Oct. 4	Application of pulsed EPR in proteins and nucleic acids  Instructor: Hedge (HSC)	Oct. 6	Introduction to computer modeling of biomolecules  Instructor: Haworth (HSC)
8	Oct. 11	Examples of model building using EPR constraints.  Instructor: Haworth (HSC)	Oct. 13	Magnetic Resonance Imaging  Instructor: Wolf (HSC)
9	Oct. 18	NMR theory  Instructor: Ulmer (HSC)	Oct. 20	NMR for bio-molecular structure determination  Instructor: Ulmer (HSC)
10	Oct. 25	Basic X-ray theory  Instructor: Chen (UPC)	Oct. 27	X-ray for bio-molecular structure determination  Instructor: Chen (UPC)

11	Nov. 1	Electron microscopy (theory and applications) Instructor: Schechter (HSC)	Nov. 3	<i>Laboratory demonstration (HSC): EPR/NMR/electron microscopy</i>
12	Nov. 8	Patch clamp; transport across membrane; Protein/small molecule localization Instructor: Chow (HSC)	Nov. 10	Amperometry or other related topic Instructor: Chow (HSC)
13	Nov. 15	<i>Student Presentations</i>	Nov. 17	Genomics and sequencing methods Instructor: Knowles (HSC)
14	Nov. 22	<i>Student Presentations</i>	Nov. 24	<i>Thanksgiving</i>
15	Nov. 29	Proteomics and mass spectrometry Instructor: Susan Lee (HSC)	Dec. 1	<i>Student Presentations</i>
	<b>Dec. 6</b>	<b>FINAL EXAM; CHEM521 &amp; BIOC522</b>		