

4:215 Biophotonics

Fall 2007

Instructor: Professor M. Lei Geng 330 IATL, Department of Chemistry
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Lecture: Tuesdays and Thursdays 2:30-3:45 pm, E105 SSH

Office Hours: Tues. and Thurs. 3:45-5:00 pm or by appointment

Textbook: Paras N. Prasad, *Introduction to Biophotonics*, John Wiley & Sons, 2003.

Reference Books: Matt Young, *Optics and Lasers*, Springer, 2000.
Daniel C. Harris and Michael D. Bertolucci, *Symmetry and Spectroscopy: an Introduction to Vibrational and Electronic Spectroscopy*, Dover.
Lakowicz, *Principles of Fluorescence Spectroscopy*, Kluwer/Plenum, 2006.

Grading: Problem sets 30%; Paper 20%; Exams 50%.

- (1) Problem Sets: Three problem sets will be given during the semester. The problem sets will be based on either the lecture materials or assigned research articles from the literature.
- (2) Paper and Presentation: Each student will select a topic in biophotonics, write a review paper on the topic, and give a fifteen-minute presentation to the class at the end of the semester.
- (3) Exams: There will be two exams in the course. The first one will be on course materials, and the second on literature.

Course Description:

Biophotonics involves the use of light to probe and manipulate biological systems, such as biomolecules, organelles, cells, and tissues. It employs photonics, the technology of generating and harnessing light and other radiant energy, for biological purposes. The course will discuss (1) fundamentals of light and its interaction with biomaterials, (2) optical sensing and probing of biological systems, and (3) manipulation of biological molecules and assemblies with photons. The course prepares students in the fields of biological spectroscopy, biosensing, biomedical optics, and bionanotechnology.

Topics of the Course:

1. Fundamentals of Interaction of Light with Biomolecules and Bioassemblies
 - Fundamentals of electromagnetic radiation and matter
 - Lasers as sources in biophotonics
 - Biomolecules and bioassemblies
 - Interactions of light with biomolecules and bioassemblies
2. Optical Sensors and Diagnostics
 - Electronic spectroscopy of biological molecules
 - Vibrational spectroscopy of biological molecules
 - Optical biosensors
 - Drug delivery
 - Diagnostic imaging: technology; imaging of subcellular components, cells, and tissues
 - Flow cytometry and microarray technology
3. Optical Manipulation of Biological Systems
 - Photodynamic therapy
 - Tissue engineering with light
 - Laser tweezers and laser scissors

Course Schedule

Dates	Lecture Topics / Assignments
Aug. 28	Introduction
Aug. 30	Fundamentals of electromagnetic waves
Sept. 4	Lasers as sources in biophotonics
Sept. 6, 11, 13	Fundamentals of matter: quantized states of atoms and molecules
Sept. 13	Problem set 1
Sept. 18, 20	Basics of biology: biomolecules, cells, and tissues
Sept. 25 – Oct. 9	Interactions of light with biomolecules and bioassemblies
Oct. 9	Problem set 2
Oct. 11	NIH study section
Oct. 11	Exam 1
Oct. 14-18	FACSS meeting
Oct. 23, 25	Vibrational spectroscopy of biological molecules
Oct. 30, Nov. 1	Electronic spectroscopy of biological molecules
Nov. 1	Problem set 3
Nov. 6	Optical biosensors
Nov. 8	Drug delivery
Nov. 13	Diagnostic imaging: techniques
Nov. 18-25	Thanksgiving recess
Nov. 15, 27	Imaging of biomolecules, organelles, cells, tissues, and whole body
Nov. 29	Flow cytometry and microarray technology
Dec. 4	Laser tweezers and laser scissors
Dec. 6	Photodynamic therapy and tissue engineering
Dec. 11, 13	Class presentations
Dec. 15, 16	Exam 2