

OSE 4721 Biophotonics

Days & Times	Room	Instructor	Meeting Dates
TuTh 4:30PM - 5:45PM	CROL 0102	Aristide Dogariu	08/24/2015 - 12/15/2015

The course addresses basic topics and current trends in the use of light in medical sciences. Students will develop an understanding of:

- light-matter interactions, optical imaging, optical technology and metrology
- opportunities for optics and photonics in biomedicine

The course will involve critical reading and current research evaluation. The course is open to non-majors; programming experience (Matlab) preferable

Key topics include a review of relevant optical principles (basic physics required) and phenomena related to light-tissue interaction. Other topics will cover aspects of optical sensing and spectroscopy, super-resolution and label-free microscopy as well as an assessment of medical applications of light for diagnostics, in-vivo imaging, and therapy

Detailed list of topics

- 1. Overview of Biophotonics**
- 2. Fundamentals of light-matter interaction (2weeks)**
 - Nature of light
 - Geometrical optics
 - Wave optics, diffraction and interference
 - Radiometry
 - Polarization and coherence
- 3. Tissue Optics (2weeks)**
 - length scales
 - optical properties; index of refraction, reflection, absorption
 - scattering; Rayleigh, Mie scattering
 - fluorescence
- 4. Optical imaging and microscopy (6weeks)**
 - Image formation
 - Contrast mechanisms
 - Microscopy and instrumentation
 - Scanning and localization microscopy
 - Optical coherence tomography
 - Diffuse optical tomography
 - Photoacoustic tomography
- 5. Optical sensing and manipulation (4weeks)**
 - Basic principles of spectroscopy and instrumentation
 - Nanotechnology; nanophotonics and array technologies.
 - Flow cytometry
 - Laser tweezers

Recommended texts (but not absolutely required)

- *Biomedical optics, Principles and Imaging*, L. V. Wang and Hsin-I Wu, Wiley-Interscience
- *Introduction to Biophotonics*, Paras Prasad, Wiley-Interscience

Other useful reading

- Optics, E. Hecht, Addison-Wesley
- Fundamentals of Photonics, B. Saleh, Wiley-Interscience
- Biomedical Photonics Handbook, T. Vo-Dinh ed., CRC Press

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies.

Grading

- 35% Homework (6 email based assignments)
- 15% Assigned project and presentation
- 20% Midterm exam
- 30% Final exams