CSBL 5083
Practical Optical Microscopy
Fall, 2017

CLASS DAYS and TIME: Tuesday and Thursday
Lecture: 12:00-12:50PM
Lab: One hour block between 1:00-4:00 PM

CLASSROOM: July 6, 11, 13, and 18: Main campus, (ROOM TBA)
July 20, 25, 27, and Aug 1: Greehey Campus, Lecture STRF (ROOM TBA)

COURSE FACULTY: James Lechleiter and Exing Wang

OFFICE LOCATION and HOURS: STRF 207.2 (Lechleiter); STRF 252.2 (Wang)

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COURSE DESCRIPTION AND OBJECTIVES

This course primarily focuses on the practical aspects of using optical microscopes. The course consists of 8 lectures and 8 laboratory demonstrations. The material presented at the lectures introduces basic principles of optical microscopy and its applications in biomedical research. The laboratory sessions are designed to reinforce the concepts presented in the lectures and to give students hands-on experience in using various types of microscopes.

Schedule of lectures:

July 6 Geometric Optics
July 11 Optical Contrast Methods
July 13 Principles of Fluorescence Imaging
July 18 Digital Detectors
July 20 Confocal Microscopy
July 25 Multiphoton Microscopy
July 27 Specialized Techniques, FRET, Super-Resolution, Ca2+
Aug 1 Image Analysis

Pre-requisites – None

Semester credit hours – 1 credit hour

Course Goals

After completing the course students are expected to:

- Understand the concept of conjugated planes and formation of transmission image. Understand bright field and commonly used contrast methods. Know how to do alignment for Kohler illumination, phase contrast, and differential interference contrast.
- Describe the mechanism of fluorescence emission and know how to align a wide-field Epi-fluorescence microscope.
- Understand how commonly used detectors, such as photomultiplier tube, CCD, CMOS, work in microscopy and why a specific type of detector is selected for a specific detection method. Understand the sources of noise and know how to improve signal to noise ratio.

- Describe how laser scanning confocal and two-photon microscope work. Understand the similarities and major differences in illumination and detection between confocal and two photon microscopy. Understand the factors that determine the spatial and temporal resolution, signal to noise ratio, photobleaching rate. Know how to optimize the instrument performance. Understand what additional considerations are required for live cell and intravital imaging.
- Understand the basic principles of specialized techniques: FRET, FRAP, TIRF, and Ca^{+2} imaging. Describe the fundamental principle how STORM super-resolution imaging work.
- Understand basic concepts in digital image processing and analysis. Know how to use arithmetic and logical operations to extract information from images. Know how to use ImageJ to do some basic image analysis.

ATTENDANCE

Students are expected to attend all lectures and labs.

GRADING SYSTEM FOR REGISTERED STUDENTS

Complete or Incomplete