جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Foundations in Bioimaging - B 316

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 316
Course Title	Foundations in Bioimaging
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	04:00 PM - 05:30 PM | Sun Wed

Instructor(s)

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Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The course starts with basic optics and spectroscopy, optical microscopy techniques, advanced fluorescence microscopy, and single-molecule imaging techniques. The course then provides with principles of electron microscopy applied to biomaterials (cells, tissues and proteins) imaging, and electron (scanning and transmission) microscopy, and some notions about both 3D SEM-based and Cryo-TEM imaging. The course finally introduces label-free optical imaging methods including Raman and infrared microscopy, holographic microscopy. Introduction to advanced methods for manipulation of single cells and single molecules (optical and magnetic tweezers), as well as principles of Atomic Force Microscopy will be also provided.
Course Description from Program Guide	This course provides a comprehensive overview of bioimaging techniques including fundamental concepts and applications, which allow biology students to design imaging experiments for their own research. The course covers basic optics and spectroscopy, optical microscopy techniques, advanced fluorescence microscopy, and single-molecule imaging techniques. The course also introduces label-free optical imaging methods including Raman and infrared microscopy, and holographic microscopy. Introduction to advanced methods for manipulation of single cells and single molecules (optical and magnetic tweezers), and correlative light and electron microscopy (CLEM) will be also provided, together with some concept about the newest in-situ transmission electron microscopy (TEM) for biological applications
Goals and Objectives	This course provides a comprehensive overview of advanced bioimaging techniques including fundamental concepts and applications, which allow biology students to design imaging experiments for their own research.

Required Knowledge	No prerequisite.
Reference Texts	Principles of fluorescence spectroscopy (J. R. Lakowicz), Handbook of fluorescence spectroscopy and imaging (M. Sauer, J. Hofkens, J. Enderlein), Single particle tracking and single molecule energy transfer (C. Brauchle, D.C. Lamb, J. Michaelis Eds.), Optics (E. Hecht), Single molecule spectroscopy in chemistry, physics, and biology (A. Gräslund, R. Rigler, J. Widengren), Infrared and Raman Spectroscopic Imaging (R. Salzer, H. W. Siesler Eds.)
Method of evaluation	**10.00**% - Attendance and Participation **30.00**% - Final exam **30.00**% - Exam 2 **30.00**% - Exam 1
Nature of the assignments	N/A
Course Policies	In accordance with the University policy and professional standards, the highest levels of academic integrity are expected in this class. The code of student conduct is strictly enforced. Academic dishonesty will result in reductions in grades and/or expulsions from this class and/or the University.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 01/27/2019 Wed 01/30/2019	Fundamentals of Light Absorption and Fluorescence / Fundamentals of Optics
2	Sun 02/03/2019 Wed 02/06/2019	Optical Microscopy Techniques / Fluorescence Microscopy
3	Sun 02/10/2019 Wed 02/13/2019	Fluorescent Protein Technologies / Fluorophores and Labeling
4	Sun 02/17/2019 Wed 02/20/2019	Fluorescence Correlation Spectroscopy / Single-Molecule Tracking
5	Sun 02/24/2019 Wed 02/27/2019	Super-Resolution Fluorescence Microscopy / Midterm Exam
6	Sun 03/03/2019 Wed 03/06/2019	What's electron microscopy and why we need it. / Scanning Electron Microscopy (SEM): *concepts and examples*
7	Sun 03/10/2019 Wed 03/13/2019	Sample preparation for SEM / SEM practical
8	Sun 03/17/2019 Wed 03/20/2019	Transmission Electron Microscopy (TEM): *concepts and examples I* / Transmission Electron Microscopy (TEM): *concepts and examples II*
9	Sun 03/24/2019 Wed 03/27/2019	Spring break
10	Sun 03/31/2019 Wed 04/03/2019	Sample preparation for TEM / TEM practical
11	Sun 04/07/2019 Wed 04/10/2019	Just something even nicer: 3D-SEM based and Cryo-TEM methods / Digital Holographic Microscopy
12	Sun 04/14/2019 Wed 04/17/2019	Second Midterm Exam / Vibrational microspectroscopy (Raman Microscopy)
13	Sun 04/21/2019 Wed 04/24/2019	Vibrational microspectroscopy (Raman Microscopy) / Hands-on experiment (Raman Microscopy)
14	Sun 04/28/2019 Wed 05/01/2019	Vibrational microspectroscopy (IR Microscopy) / Vibrational microspectroscopy (IR Microscopy)
15	Sun 05/05/2019 Wed 05/08/2019	Plasmonics / Optical Tweezers
16	Sun 05/12/2019 Wed 05/15/2019	Atomic Force microscopy / Hands-on Atomic Force Microscopy
17	Sun 05/19/2019 Wed 05/22/2019	Final exam

Note

The instructor reserves the right to make changes to this syllabus as necessary.