

OPTICAL MICROSCOPY AND IMAGING IN THE BIOMEDICAL SCIENCES

September 7– September 17, 2016

COURSE SCHEDULE

Wednesday, September 7

ORIENTATION 7:00 p.m. SPECK AUDITORIUM – Rowe Bldg.

Introductions

Faculty and Students

Overview of course

Robert Hard, Hari Shroff

PIZZA PARTY 7:45 p.m. Lobby, Second Floor, Loeb

*Lectures will be in Speck Auditorium - Rowe Bldg (SA) or Room G-70– Basement, Loeb Building (LG)
Laboratories will be in the main lab, 2nd floor, Loeb (L)
Meals will be in Swope (SW) dining room, 2nd floor*

Thursday, September 8

8:15 SA Welcome from Dr. Rae Nishi, Director of Education, MBL
8:30 SA Geometric optics, the microscope and image formation Hard
9:30 L Coffee
10:00 SA Image formation (continued)
11:00 L Simple specimen preparation technique Hard and DePasquale
Live Cell Imaging Requirements
12:00 SW Lunch
1:00 L Create an optical bench microscope + exercises Hard, Shroff, Sigurdson
3:00 L Practice in use of commercial microscope stands Commercial Faculty
Parts, buttons
Koehler illumination
Use of diaphragms
6:00 SW Dinner
6:50 L Vendor meeting Hard, Shroff/Sigurdson
7:00 SA Wave Optics, Diffraction and Abbe's theory Hard
8:30 L Demonstration: Abbe diffraction apparatus McIlvain, Hard
9:00 L Discussion of diffraction Hard/Shroff

Friday, September 9

8:15 SA Dark Field and Phase Contrast microscopy Hard
9:00 SA Interference reflection microscopy DePasquale
9:30 L Coffee

10:00	L	Laboratory: Resolution tests.	
12:00	SW	Lunch	
1:00	L	Phase Contrast, Dark-field Microscopy, Interfer. Refl. Demo	Commercial Faculty Depasquale
2:30	L	ImageJ basics	Sigurdson
3:00	SA	Cameras I Camera Features Affecting Image Quality	Fullerton
3:45	L	Laboratory: Use of digital cameras Image Basics I	Commercial faculty Commercial faculty
5:00	L	Problem Set 1 Digital cameras, resolution test slide, phase contrast	Students Only
6:00	SW	Dinner	
6:50	L	Vendor meeting	Hard/Shroff/Sigurdson
7:00	SA	Polarization microscopy I	Hard
8:30	L	Laboratory: MacroPol exercises	Hard and Sigurdson

Saturday, September 10

8:15	L	Presentations, Problem Set 1	
8:45	SA	Polarization microscopy II	Hard
9:45	L	Coffee	
10:15	L	Laboratory: Polarization microscopy	Hard, Sigurdson, Commercial Faculty
12:30	SW	Lunch	
1:30	SA	Differential interference contrast microscopy	Hard
2:45	L	Laboratory: Differential interference contrast microscopy	Commercial Faculty
5:30	SW	Dinner	
6:20	L	Vendor meeting	Hard/Shroff/Sigurdson
6:30	L	Laboratory: Image Basics II	Commercial Faculty
7:00	L	Laboratory: Digital Imaging, Phase, Dark Field, DIC and POL exercises/photos	Hard, Commercial Faculty
9:00	L	Problem Set 2 Digital cameras, POL and DIC	Students Only

Sunday, September 11

8:00	L	Presentations, Problem Set 2	
8:45	SA	Coherence to Incoherence & Specimen Noise Limitations in Each	Hard
9:00	SA	Introduction to fluorescence	North
10:30	L	Coffee	
11:00	SA	Laboratory: Fluorescence microscopy	North, DePasquale, Commercial Faculty
12:30	SW	Lunch	
1:30	SA	Advanced fluorescence microscopy I Colocalization, TIRF, Live Cell Imaging	North
2:30	L	Laboratory Demonstration: Spectra and Optical Filter Properties	Commercial
3:00	L	How to Clean Fluorescence Filters	Faculty
3:15	L	Fluoresc. Microsc., continued (visual observations of fixed cells)	North, DePasquale
4:45	SA	Cameras II: Cooled CCD and CMOS cameras/SNR	Fullerton
5:30	SW	Dinner	
6:20	L	Vendor meeting	Shroff/Hard/Sigurdson
6:30	L	A, B, C's of fluorescent specimen preparation	DePasquale
7:00	L	Discussion of fluorescent specimen preparation	DePasquale

7:15 L	Lab: Characteristics of low-light level cameras; calculating photoelectrons/SNR	Fullerton Comm. Faculty
8:15 L	Problem Set 3 Low-light level cameras and image processors with fluorescent labeled specimens	Students Only
9:30 L	Open discussions	Shroff/Hard

Monday, September 12

8:15 L	Presentations, Problem Set 3	
9:00 SA	Advanced Fluorescence II Fluorescent proteins for monitoring live cell function	Day
10:00 L	Coffee	
10:30 SA	Advanced Fluorescence III FRAP/FLIP, Photoactivation, Photoswitching, Fluorescent Correlation Spectroscopy-live cells, Fluorescence Polarization	Day
	Advanced Fluorescence IV – Intro FRET, FLIM, Fluorescence Pol. and FRET, Fret Measurements, Fluor. Proteins for FRET	Day
11:30 SA	Discussion, fluorescence methods	Day/North
12:00 SW	Lunch	
1:00 L	FRET/FLIM Demo	Day/Clemenceau/van Gorsel
3:30 SA	Digital Imaging Principles	Preza
6:00 SW	Dinner	
6:50 L	Vendor meeting	Hard/Shroff/Sigurdson
7:00 SA	Summary-Classes of Fluorescent Dyes	Commercial (MolecProbes)
7:30 L	Demonstrations: Digital image processing	Preza, Commercial Faculty
10:00 L	Open Discussions	Hard/Shroff/Preza

Tuesday, September 13

8:15 L	Discussion on digital image processing	
9:00	Coffee	
9:30 SA	Digital Image Restoration (Deconvolution)	McNally
10:30 SA	Evaluating optical performance using PSFs	Goodwin
11:30 SW	Lunch	
12:30 SA	Light Sheet microscopy	Shroff
1:15	Break	
1:30 L	Lab: Build a widefield fluorescence microscope	Shroff/Hard
3:30 SA	Horizons Lecture: Title TBD	Joerg Bewersdorf
4:30 L	Free time on instruments	
5:50	Vendor meeting	Shroff/Hard/Sigurdson
6:00 SW	Wine and Beer - Lounge	
6:30 SW	Banquet, Landfall Restaurant, Woods Hole	
8:30	Free time, Continued	

Wednesday, September 14

8:30	SA	Confocal scanning microscopy	McNally
9:30	SA	Multiphoton Imaging	McNally
10:00	L	Coffee	
10:30	L	Laboratory: Quantitative Deconvolution/Confocal/Multiphoton	McNally/Murray Commercial Faculty
		Overview of lab; Image J tutorial on calculations for lab	
12:30	SW	Lunch	
1:30	L	Quantitative laboratory, Continued	McNally/Murray Commercial Faculty
5:30	SW	Dinner	
6:15	L	Vendor Meeting	Shroff/Hard/Sigurdson
6:30	L	Quantitative Laboratory (con't)	Murray/McNally

Thursday, September 15

8:30	L	Discussion, 3D Imaging Labs	Murray/McNally/ Shroff/Hard/Sigurdson
10:30	L	Coffee	
11:00	L	Discussion, 3D Imaging Labs (Con't)	
12:30	SW	Lunch + Class Photo	
1:30	LG	Super-Resolution – STED, PALM, STORM, GSD	Shroff
1:30	L	Data processing tutorial: PALM/STORM	Elliott
3:00	L	Demonstrations: STED, PALM, STORM, GSD -Nikon NSTORM/Andor Dragonfly/GE OMX	Shroff, Commercial Faculty
5:00	SW	Dinner	
5:50	L	Vendor meeting	Shroff/Hard/Sigurdson
6:00	LG	Super-Resolution – Structured Illumination, SIM	Goodwin
7:00	LG	Analogue SIM	Coleman
7:30	LG	Airyscan	McIlvain
8:00	L	Demonstrations: Structured Illumination, SIM	Shroff, Elliott, Goodwin and Commercial Faculty
9:30	L	Open discussions	Shroff/Hard

Friday, September 16

8:30	L	Discussion, Super-resolution microscopy	
9:30	L	Free time on instruments	
12:00	SW	Lunch	
1:00	LG	GRAND SUMMARY	Lanni
3:15	L	Demonstrations: Light sheet microscopy Thorlabs: build your own microscope Phase Holographic Imaging Spinning Disk Confocal + Apotome TIRF/FRAP Orientation-Independent POL and DIC (60 min) Free time on instruments	Technical Instruments Thorlabs Commercial Faculty Commercial Faculty Commercial Faculty Oldenbourg and Shribak
6:15	SW	Dinner	
7:15	LG	Adaptive Optics	Phillippe Clemenceau
7:45	L	Adaptive Optics Demo	Phillippe Clemenceau

8:45 THE KIDD Open discussions

Academic/Commercial Faculty

Saturday, September 17

7:00 SW Breakfast and Departure