

PHYS/BEST 231

Imaging and Spectroscopy for Interdisciplinary Biophysical Sciences, Biomaterials and Biotechnology

Fall, 2018

PROFESSORS: Joel Spencer / Eva de Alba

Office Hours: Wednesday (11:00 am-12:00 pm). S&E Building 2. Rm 381 (Joel Spencer), and 382 (Eva de Alba).

E-MAIL: joel.spencer@ucmerced.edu / edealbabastarrechea@ucmerced.edu

LECTURE: Mondays (1:30 pm - 3:20 pm). COB 264. From August 22nd to Dec 7th.

DISCUSSION SECTIONS: Mondays (3:30 pm - 4:20 pm). COB 264. From August 22nd to Dec 7th.

REQUIRED TEXT: This course does not require textbooks. However, the following reading is recommended:

1) Principles of Fluorescence Spectroscopy. 3rd Edition by Joseph R. Lakowicz. Springer ISBN: 978-0387312781.

2) Biomedical Optics: Principles and Imaging. 1st Edition by Lihong V. Wang and Hsin-I Wu. Wiley ISBN: **978-0-471-74304-0**.

3) Additional readings: Reviews on the different topics recommended by the instructors.

All necessary course materials will be posted on CatCourse, and course related announcements will be made through the email list maintained by the site as well.

I. COURSE OVERVIEW:

1. **Lectures:** Lectures will cover cutting-edge applications of imaging and spectroscopy tools to problems in biophysical sciences, biomaterials and biotechnology.
2. **Team Projects:** Teams of students will discuss research projects and published work to gain in-depth understanding on the application of imaging and spectroscopic techniques to different scientific/engineering questions and applications. Analysis of research projects/published work will require to formulate the problem, literature survey, developing and/or explaining proposed experimental schemes to address the problem/application.

II. COURSE LEARNING GOALS AND OUTCOMES:

By the end of this course, students will:

1. Have a good understanding of the various state-of-the-art imaging and spectroscopic techniques and be able to identify relevant techniques to address specific problems.
2. Have gained the ability to follow current research and literature in Interdisciplinary Biophysical Sciences, Biomaterials and Biotechnology.
3. Be able to breakdown problems so that they can be addressed in a reasonable and tractable fashion using the relevant techniques.
4. Be able to utilize imaging and spectroscopy techniques to gain information about the system at hand.
5. Be able to communicate their findings both orally and in written form.

III. RELATION TO THE FOLLOWING ABET PROGRAM LEARNING OUTCOMES (PLOS):

BEST GRADUATE PROGRAM PLOS:

1. Possess a broad foundation in the fundamentals and current topics in either biological or materials science and engineering, as well as, an in-depth understanding of their chosen research topic area. (PhD; MS1; MS2).
2. Exhibit the quantitative experimental and analytical skills necessary to conduct and lead independent research and contribute to knowledge in their chosen area. (PhD; MS1).
3. Be able to identify new, important, and interesting research opportunities, and be able to develop effective strategies, including the experimental plan, for pursuing these opportunities. (PhD only).
4. Communicate both fundamental concepts and details of their own research effectively, both in written and oral form, including in a classroom setting to expert and non-expert audiences. (PhD; MS1; MS2).
5. Be able to critically evaluate the experimental design, data analysis and data interpretation of our peers. (PhD only).

PHYSICS GRADUATE PROGRAM PLOS:

1. Possess a broad foundation in the fundamentals of physics and a deep understanding of their chosen subfield, which will permit them to understand and critically evaluate current research. (PhD and MS).
2. Have the experimental, theoretical, and/or computational skills necessary to conduct and lead independent responsible research and contribute to knowledge in their chosen subfield. (PhD only).

3. Identify new research opportunities, which may cross traditional discipline boundaries, plan effective strategies for pursuing these opportunities and conduct research that makes a new contribution to knowledge in their chosen subfield of physics and solve important problems in society. (PhD only).
4. 4. Communicate both fundamental concepts of physics and details of their own research effectively, in written and oral form, including in a classroom setting to expert and non-expert audiences. This includes the publication of original research results in peer reviewed scientific journals. (PhD and MS).
5. Be proficient in professional skills necessary to lead a productive career in physics or a related career. (PhD and MS).

IV. COURSE POLICIES:

1. Attendance is mandatory. Points will be deducted for unexcused absences or complete lack of participation. Please, no cell phones or recording devices are allowed in class.

2. Discussion Sections: Discussion sections are provided to help the student learn and understand the material from lectures. Students need to come to discussion sections prepared with questions and participate actively on them to get their full value.

V. COURSE REQUIREMENTS AND GRADING:

Prerequisites: This course requires an introduction to state-of-the art imaging and spectroscopy techniques offered through the NSF-CREST CCBM IB3 Summer Training Module on Imaging and Spectroscopy.

Grading for PHYS/BEST 231

50% Exams:

First Midterm Exam – 25%

Second Midterm Exam – 25%

50% Projects:

2 projects in written form, 10% each

2 projects requiring oral presentations, 15% each.

Exam dates/times cannot be modified for anyone unless there is written and certified justification of the need to change.

The final course grade will be calculated from the overall numerical score obtained during the course converted onto a letter grade according to the following recipe:

A+ : 99%-100%

A : 95%-<99%

A- : 90%-<95%

B+ : 87%-<90%

B : 83%-<87%

B- : 80%-<83%

C+ : 77%-<80%

C : 73%-<77%

C- : 70%-<73%

D+ : 67%-<70%

D : 63%-<67%

D- : 60%-<63%

F : 0%-<60%

VI. TENTATIVE LECTURE SCHEDULE FOR FALL 2018 (Note: Lecture schedule might be modified)

Schedule	Instructor: Professor Joel Spencer
Week 1: August 27th	Overview of imaging and spectroscopy
Week 2: September 3rd	Labor Day Holiday
Week 3: September 10th	Confocal and multiphoton microscopy
Week 4: September 17th	Coherent Raman imaging and live microscopy techniques
Week 5: September 24th	Superresolution microscopy techniques
Week 6: October 1st	Single molecule imaging
Week 7: October 8th	X-ray diffraction
Week 8: October 15th	FIRST MIDTERM EXAM
Schedule	Instructor: Professor Eva de Alba
Week 9: October 22nd	Circular Dichroism / Mass Spectrometry
Week 10: October 29th	NMR Spectroscopy of Multiprotein Complexes (I) ○ General background on protein NMR ○ Chemical shift mapping ○ NOEs
Week 11: November 5th	NMR Spectroscopy of Multiprotein Complexes (II) ○ Residual Dipolar Couplings ○ Paramagnetic Restraints ○ Cross-Saturation ○ Selective isotope labeling techniques
Week 12: November 12th	Veterans Day Holiday
Week 13: November 19th	Fluorescence Spectroscopy ○ Principles of Fluorescence Spectroscopy (Instrumentation, fluorophores, bleaching, anisotropy...) ○ FRET: Förster Resonance Energy transfer ○ TIRF: Total Internal Reflection Fluorescence ○ FRAP: Fluorescence Recovery After Photobleaching ○ FCS: Fluorescence Correlation Spectroscopy
Week 14: November 26th	Transmission Electron Microscopy ○ Principles of TEM ○ Cryo-EM
Week 15: December 3rd	Optical traps
Week 16: December 10th	SECOND MIDTERM EXAM

Academic Dishonesty Statement:

- a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
- b. Students are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. Students can give "consulting" help or receive "consulting" help from other students. However, this permissible cooperation should never involve one student team copying the work from another team. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
- c. During examinations, students must do own work. Talking or discussion is not permitted during the examinations, nor may students compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Disability Statement:

Accommodations for students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Counseling and Psychological Services:

The mission of UC Merced Counseling and Psychological Services (CAPS) is to support the mental health and well-being of our students. It is the intention of all CAPS staff to provide a safe, confidential atmosphere of acceptance and accessibility to professionals in the field of psychology.

Contact Information (Confidential Help)

Phone: (209) 228-4266
counseling@ucmerced.edu

Discrimination & Sexual Violence Prevention:

The University of California is committed to creating and maintaining a community where all individuals who participate in university programs and activities can work and learn together in an environment free of harassment, exploitation or intimidation.

Contact Information

Phone: (209) 285-9510
msalvador2@ucmerced.edu, Michael Salvador, Director of Compliance.

CARE Office:

Campus Advocacy, Resources, & Education (CARE) provides prevention education for the UC Merced community to achieve an environment free from the threat of sexual violence,

dating/domestic violence, and stalking. They provide free and confidential assistance for all UC Merced affiliates (including Undergraduate students, Graduate students, Staff and Faculty.

Contact Information (Confidential Help)

Campus Advocate: Valara Villanueva
(209) 386-2051

Food Assistances (HEROES):

CalFresh is a monthly stipend system to purchase food at markets and food stores.

Contact Information

Phone: 209-228-41320
heroes@ucmerced.edu