

BISC 499 Special Topics
Microscopy and Spectroscopy of Biological Systems
Units: 2
Fall 2018—Tuesdays 2:00pm-3:40pm

OFFICE: MCB Conference Room

Instructors: Dr. Cosimo Arnesano, Dr. Scott E Fraser
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Course Description

Microscopy and spectroscopy are critical players in biological and medical research as they allow scientists to understand key mechanisms in cells and tissues non-invasively. These techniques are widely used by biologists, chemists, physicians, and in general all scientists that are dealing with the study of biological and medical processes. There is therefore the need to disseminate the underlying principles of these methods to students, especially in the biological and biomedical fields.

Class will have a “theoretical” part where we cover the basic principles, techniques and applications of microscopy and spectroscopy, and a “hands on” part where students will be using microscopes to perform real experiments using techniques learned in the theoretical part.

Learning Objectives

The goal of this course is to provide a strong background on cellular and tissue biophotonics from an integrated systems point of view. Several approaches and techniques, with a focus on critical thinking and problem based learning, will be utilized to show how basic science is applied for solving biological and medical problems. Reading will be assigned as needed for the group projects from a mix of classic and current peer-reviewed papers selected by the groups.

Students that will successfully complete this course will be able to critically assess a biological/medical problem and will solve the related questions with the technologies learned in class.

Recommended Preparation: BISC 220, BISC 330, PHYS 135ab, MATH 125

Course Notes

Blackboard will be used for posting lecture notes and other material relevant to the class. Material will be provided week by week and posted on BlackBoard. I will try to follow selected chapters from the books I suggested so it will be easier for students to review what covered in class.

Technological Proficiency and Hardware/Software Required

SimFCS software will be used for analyzing some data provided to students.
(Free 1-month license)

Recommended Readings and Supplementary Materials

1. ***Molecular Fluorescence: Principles and Applications***, Second Edition Author(s): Prof. Dr. Bernard Valeur, Prof. Mário Nuno Berberan-Santos
<http://onlinelibrary.wiley.com/book/10.1002/9783527650002>
2. ***Principles of fluorescence spectroscopy***. Author(s): Lakowicz, Joseph R
<http://kemia.unideb.com/pr/Principles of Fluorescence Spectroscopy.pdf>
3. **Introduction to Fluorescence**, David M. Jameson, Taylor & Francis, Jan 22, 2014
4. **Natural Biomarkers for Cellular Metabolism: Biology, Techniques, and Applications**
Vladimir V. Ghukasyan, Ahmed A. Heikal

Description and Assessment of Assignments

Grading Breakdown

Assignment	Points	% of Grade
Class participation/discussion	100	10
In class quizzes	100	10
Journal club:article presentation	100	30
Final Exam	100	50
TOTAL	400	100

30% Journal Club and article presentation:

Students will team up and choose a paper to discuss in their presentation from a list I will provide. We will discuss the journal articles, and the team will be in charge of leading the discussion. I will provide some guidelines to follow in class, but here are some suggestions relating to preparing for a presentation:

1. Split the presentation up between the presenters (all team members need to present)
2. List the main goals, methods and results of the study
3. Explain methods using other means such as whiteboard
4. Facilitate discussion of strengths and weaknesses of the article.
5. Briefly describe related work since the publication.
6. Provide a list of related references

10% Class Participation/Discussion:

Each student is expected to read the articles (of all the groups) BEFORE class, and prepare a question conceptualizing and evaluating the paper.

10% In class Quizzes:

Short assessments in the form of multiple choices/short answer questions and covering previous classes topics will be held at the beginning of the class and last for about 10 minutes.

50% Final Exam:

It will consist of a set of short answer questions and case scenarios where students need to identify potential biological/medical problems and propose imaging approaches learned in class that can be used to solve those problems.

Grading Scale

Course final grades will be determined using the following scale

A	95-100
A-	90-94
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

Assignment Submission Policy

Quizzes will be turned in in class after their completion (first 10-15 minutes of some classes)
Selected articles for group presentations need to be specified via email (arnesano@usc.edu)

Additional Policies

There will not be any make up Assignments. If you have a legitimate and documented reason to miss any of the four presentations, you will need to submit a one page write up on a group presentation's topic.

Academic Dishonesty: Any evidence of academic dishonesty on any feature of the course will result in an automatic failing grade for the course.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1	Introduction to Fluorescence	Notes on BB	
Week 2	Introduction to Microscopy principles and techniques	Notes on BB	Groups formation for journal club
Week 3	Laser Scanning Microscopy (LSM), Confocal Microscopy and Multiphoton Microscopy	Notes on BB	In class Quiz1
Week 4	Practicum on LSM	Notes on BB	
Week 5	Natural Biomarker for biophotonics	Notes on BB	In class Quiz2
Week 6	FLIM, FRET and clinical applications	Notes on BB	
Week 7	Practicum on FLIM	Notes on BB	In class Quiz3
Week 8	FLIM data analysis using SimFCS software	Notes on BB	
Week 9	FRAP and quantitative Hyperspectral Imaging (HySp)	Notes on BB	In class Quiz4
Week 10	Practicum on HySp	Notes on BB	
Week 11	Introduction to Fluorescence Correlation Spectroscopy (FCS)	Notes on BB	In class Quiz5
Week 12	Article discussion #1	Notes on BB	Group #1 presentation
Week 13	Article discussion #2	Notes on BB	Group #2 presentation
Week 14	Article discussion #3	Notes on BB	Group #3 presentation
Week 15	Article discussion #4	Notes on BB	Group #4 presentation
FINAL	Final Exam		Date: For the date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at classes.usc.edu .

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic

dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.

Provides overall safety to USC community. dps.usc.edu