EEC 245 / EMS 245 / ECH 245 – Micro- and Nano-technology in Life Sciences
4 units – Winter Quarter 2016

Objective: The integration of microfabrication, nanotechnology, and the life sciences has generated powerful tools to study biological questions, as well as to diagnose and treat diseases. The unifying objective of this interdisciplinary course is to train students from different backgrounds to be conversant across multiple disciplines and acquire skills to approach complex biomedical problems.

Class Times/Location: Monday and Wednesday 10:00AM-11:50AM Wellman 103

Prerequisite: Graduate Standing (or instructor approval)

Instructor: Prof. Erkin Şeker (eseker@ucdavis.edu); Office: 3177 Kemper Hall

Office Hours: Monday and Wednesday; 1PM-2PM

Teaching Assistant: Ozge Polat (okurtulus@ucdavis.edu); TA office hour by email request

Grading: Letter; final grade will be based on homework assignments (35%), a midterm exam (20%), a final project report (30%), and in-class presentations (15%).

Homework: There will be 5-6 homework sets which will be assigned approximately a week before they are due.

Midterm Exam: The in-class exam will cover the topics up to the midterm. A make-up exam will not be given unless cases of extreme extenuating circumstances arise.

Final Project: Students will be asked to propose a microdevice and provide a thorough analysis at mechanical, electrical, and biological levels. The project report will be formatted to serve as a foundation for pre-doctoral fellowship applications, thereby training students on essential proposal writing skills.

Presentations: Students will be asked to present their final project. Specific instructions will be given.

Attendance & Late Submission Policy: Class attendance is mandatory during the last two lectures, during which all students will participate in critiquing the presentations. Assignment submissions (including homework, midterm, final project, peer-reviews) will be done electronically on SmartSite. Assignments submitted after deadline up to 24 hours will have 20% deducted; between 24 hours and 48 will have an additional 20% deducted. Any submission later than 48 hours will not be accepted.

Computer Use: ImageJ (NIH free image processing software) will be used for some homework assignments. Specific instructions will be given.

Textbooks: Relevant reading material and exercises will be provided by the instructor.

Academic Integrity:
Cheating and plagiarism will not be tolerated. Professional integrity is an important aspect of all engineering disciplines, and understanding the material in these courses is integral to becoming a proficient and productive engineer. As such, it is imperative that you spend the time and effort to fully understand the material. Please read the UC Davis “Code of Academic Conduct” for further details: http://sja.ucdavis.edu/files/CAC.PDF

Course Content:

1. **Micro- and Nano-Manufacturing**. We will examine key micro- and nano-fabrication techniques and discuss relevant processing and characterization instruments. There will be a special emphasis on the challenges and design considerations in process development.
2. **Surface Science and Mass Transfer.** We will review techniques to engineer advanced surfaces by modulating morphology and chemistry. In addition, we will discuss 3D morphology and its implications on molecular transport within and from functional device coatings.
3. **Essential Biology.** Following an introduction to basic anatomy, physiology, and pathology, we will study how living organisms interact with inorganic devices. We will emphasize the ways tissues respond to biomedical devices and how this response can be tuned by modulating device properties.
4. **Devices.** We will survey important device components such as biosensors and actuators that are built using the tools discussed in Sections 1 and 2 with a special emphasis towards addressing the biological requirements/constraints outlined in Section 3.
5. **Applications.** The fundamental knowledge acquired up to this point will be put in context by deconstructing existing and developing technologies. Examples will include bioimplantable devices for treating medical disorders. Additional examples will be discussed in accordance with the interests of the class.

Approximate timeline:

Week	Date	Day	Topic
1	1/4	M	Introduction & Course outline
	1/6	W	Microfabrication
2	1/11	M	Microfabrication
	1/13	W	Nanofabrication
3	1/18	M	*HOLIDAY*
	1/20	W	Characterization
4	1/25	M	Surface science
	1/27	W	Mass transfer
5	2/1	M	Materials & Process design
	2/3	W	*MIDTERM*
6	2/8	M	Grant proposal
	2/10	W	Anatomy & Physiology
7	2/15	M	*HOLIDAY*
	2/17	W	Pathology
8	2/22	M	Sensors & Actuators
	2/24	W	Biological models
9	2/29	M	Biotic-abiotic interface
	3/2	W	*TBA*
10	3/7	M	Big picture
	3/9	W	Presentations
11	3/14	M	Presentations