

ABE/AME 489B/589B Bio Micro/Nanotechnology Applications (Spring 2008)

TR 11–12:15 Shantz 440

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Dr. Joel L. Cuello (Shantz 507, 621-7757, jcuello@ag.arizona.edu)

Description: This course tackles the applications of modern micro/nano devices or systems including lab-on-a-chip, DNA/protein array, drug carriers and other therapeutic systems, neuroscience applications, and food/agricultural systems. Toward this end, three different topics will be covered in this class: (1) brief overview on modern micro- and nanofabrication technologies, (2) biophysics principles for analytes and its recognition, and (3) various sensing modalities specific to these systems.

Grading: Regular grades are awarded for this course: A B C D E.

Prerequisite(s): CHEM 103A, and CHEM 103B or MSE 110; Basic familiarity with cells, proteins and DNAs.

Usually offered: Spring, alternate years.

Course Objectives

1. To understand the biophysics principles for analytes and its recognition (Riley).
2. To understand the sensing modalities for these analytes in the micro- or nano-devices (Cuello).
3. To understand various micro- and nanofabrication techniques for lab-on-a-chip, microarray, and drug carrier devices (Yoon).
4. To apply engineering and biological fundamentals to the design of micro- or nano-devices or systems towards creating a profitable business model (for 489B) or a new research activity (for 589B).

<u>Grading Criteria</u>	<u>489B</u>	<u>589B</u>	<u>Grading Scale</u>	
Exam (3 total)	60%	50%	90.0 – 100.0	A
Homework (12 total)	20%	20%	80.0 – 89.9	B
Journal club		10%	70.0 – 79.9	C
Term paper (team effort)	20%	20%	60.0 – 69.9	D
			< 60.0	E

Class Policies

1. Attendance in each lecture session is required.
2. A valid excuse from taking a scheduled exam can only be obtained by calling or e-mailing the instructor no later than 48 hours before the exam is given.
3. Each homework and term paper that is submitted late will be penalized by reducing its score by 50% for each day that it is late.
4. Homework is to be turned in individually, except where explicitly noted.
5. Adherence to official university rules and regulations pertaining to the classroom is mandatory.
6. The office hour of the instructor will be announced in class.

Journal Club (589B only)

1. Students enrolled in 589B should make 2 journal critiques (journal club): one of which to be presented for about 10 min during the lecture (no write-up is required) and the other to be submitted as about 10-page write-up (no oral presentation is required).
2. Students enrolled in 489B are not required to make journal critiques, but the attendance to 10-min presentation is required.
3. The order of oral presentations will be announced on the first day of lecture. The written critique can be submitted any time during the semester, but no later than April 30th.
4. The choice of journal articles should be notified to Jeong-Yeol Yoon (jyoon@email.arizona.edu) one week prior to an oral presentation or a written report. This choice will be posted on a course website, to prevent for the students to work on the same paper.

Term Paper

1. Term paper is a team effort, comprised of 2-3 students. 4-student team is not allowed without the instructors' consent. 489B students cannot make a team with 589B students, or vice versa. Each team will make a single

presentation and submit a single term paper, although all team members should participate in both presentation and term paper writing.

2. The format of term paper will be different for 489B and 589B students. 489B students should prepare a term paper of “engineering design” type. Extensive theoretical background is not required and the idea may not necessarily be entirely novel. However, the final design should be as elaborate as possible towards a prototype equipment or system. 589B students will write a grant proposal to the external funding agencies, such as NSF or NIH.

Special Needs and Accommodations

Students who need special accommodation or services should contact the SALT (Strategic Alternatives Learning Techniques) Center for Learning Disabilities (SALT Center, Old Main PO Box 210021, Tucson, Arizona 85721-0021, (520) 621-1242 FAX (520) 621-9448 TTY (520) 626-6072), <http://www.salt.arizona.edu>, and/or the Disability Resources Center, 1540 E. 2 nd Street, PO Box 210064, Tucson, Arizona 85721-0064, (520) 621-3268, FAX (520) 621-9423, <http://drc.arizona.edu>. The need for accommodations must be documented by the appropriate office.

Student Code of Academic Integrity

The University’s Code of Academic Integrity (Section 2.1a) states that students shall not “represent the work of others as their own.” This policy will be applied to all work submitted for a grade, including exams, term papers, homework assignments and journal club presentations. You are welcome to work with your classmates on the homework. The minimum penalty for cheating on exams is an E grade.

Confidentiality of Student Record

<http://www.registrar.arizona.edu/ferpa/default.htm>

Schedule

Tuesdays

1/22 Riley: Protein structure
1/29 Riley: Molecular associations
2/05 Riley: Nucleic acids as structural materials
2/12 Riley: Biomolecular motors
2/19 Riley: Exam I
2/26 Cuello: Transducers
3/04 Cuello: Optical sensing
3/11 Cuello: Optical fibers
3/18 *No class: spring break*
3/25 Cuello: Food & agricultural applications (+JC)
4/01 Cuello: Exam II
4/08 Yoon: Top-down nanofabrication techniques
4/15 Yoon: DNA array
4/22 Yoon: Lab-on-a-chip & microfluidics
4/29 Yoon: Drug delivery actuators (+JC)
5/06 Yoon/Riley/Cuello: Term paper review
5/15 Yoon/Riley/Cuello: Term paper presentations (during final exam week)

Thursdays

1/17 Yoon: History of bioMEMS/bionanotechnology
1/24 Riley: Protein folding models
1/31 Riley: Allosteric interactions
2/07 Riley: Energy collection (+JC)
2/14 Riley: Integration (+JC)
2/21 Cuello: Biosensing modalities
2/28 Cuello: Electrochemical sensing
3/06 TBA
3/13 Cuello: Piezoelectric & thermal sensing
3/20 *No class: spring break*
3/27 Cuello: Environmental applications (+JC)
4/03 Yoon: Microfabrication techniques
4/10 Yoon: Bottom-up nanofabrication techniques
4/17 Yoon: Protein array
4/24 Yoon: Medical applications (+JC)
5/01 Yoon: Exam III

Links

Course website TBA

Protein data bank <http://www.pdb.org>

Biological Engineering <http://www.asabe.org/pubs/biological%20engineering.html>

Biosensors and Bioelectronics <http://www.sciencedirect.com/science/journal/09565663>

Lab on a Chip <http://www.rsc.org/Publishing/Journals/lc/index.asp>

Nano Letters <http://pubs.acs.org/journals/nalefd/index.html>

Journal of Biological Engineering <http://www.jbioleng.org>