

USC Viterbi School
of Engineering

DRAFT SYLLABUS

BME 506 Bioengineering of Disease and Cell Therapeutics

Units: 4

Spring, MW, 12:00-1:50pm

Location: TBD

Instructor: Keyue Shen

Office: DRB 316

Office Hours: MW 2:00-3:00pm

Contact Info: keyue.shen@usc.edu, Office: 213-740-0380.

Timeline for replying to emails/calls: within 48 hours.

Teaching Assistant: TBD

Office: TBD

Office Hours: TBD

Contact Info: TBD

Course Description

Human diseases, such as cancer and immune disorders, are largely driven by dis-regulated cell-cell and cell-microenvironment interactions. Conversely, decoding the languages cells use for these communications will enable the next generation of diagnostic and biomedicine development. Bioengineering offers unique abilities in understanding disease progression and developing novel therapeutics. This course will use case studies to introduce students to exciting applications of engineering approaches, including micro- and nano-technologies, microscopy and single-cell techniques, materials and surface chemistry, in cancer, immunology, and immunotherapy. It will also acquaint students with concepts of physiology and pathophysiology as well as animal disease models in biomedical research. This course is designed for graduate students who are interested in pursuing research at the intersection of micro-/nano-engineering, materials science, biology, and medicine.

Learning Objectives

Students will be able to:

- Understand the current bioengineering techniques and their applications in complex biomedical problems.
- Learn the basic concepts of physiology, pathology, and animal disease models.
- Identify major questions and focal areas in cancer and immune system bioengineering
- Develop skills in written and oral research communications as well as peer discussion and evaluation.

Recommended Preparation: General cell biology (e.g. BISC 101Lxg) and chemistry (e.g. CHEM 103Lxg).

Course Notes

Copies of lecture slides and other class information will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Course materials (syllabus, lecture slides, homework assignments, etc.) will be available through Blackboard (<http://blackboard.usc.edu/>)

Supplementary Materials

The course recommends the following textbooks (not required):

- Fundamentals of Microfabrication and Nanotechnology, 3rd edition, Volume II (Manufacturing Techniques for Microfabrication and Nanotechnology), by Marc J. Madou, CRC Press, 2011 (can be purchased on Amazon.com or other online/brick-and-mortar bookstores)
- The Biology of Cancer, 2nd edition, by Robert A. Weinberg, Garland Science, 2013 (can be purchased on Amazon.com or other online/brick-and-mortar bookstores)
- Cellular and Molecular Immunology, 8th edition, by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Saunders, 2014. (available electronically through USC library)

Additional reading materials will be provided through Blackboard.

Description and Assessment of Assignments

Homework (100 points each): There will be four homework sets which will be assigned a week before they are due. All questions will be analytical, based on research questions and techniques/concepts introduced in class. The assessment will be based on the pertinent usage of the techniques and concepts to the presented research questions. Assignments are due on the specified date at the beginning of class.

Midterm Exam (100 points): A midterm exam will cover the topics up to the midterm and will be assigned and due in class. There will be no make-up exam. The midterm includes:

- 1) True or false (30 points)
- 2) Analytical questions (70 points)

Journal Club (100 points): Each student will present a journal article (based on a typical enrollment of 12 students). Prof. Shen will introduce the overall background of the covered areas in the first 60 minutes, followed by a presenter in each class. For each presenter, the presentation will be 35 minutes with PowerPoint slides + 15 minutes of discussion. Presentations will be evaluated by Prof. Shen (50 points), with the following criteria and weight:

- 1) Background: introduction of the field, critical problem, significance (30%)
- 2) Research: experimental design, novelty, key results (20%)
- 3) Discussion: implication, limitation, and potential extension of the work (20%)
- 4) Leading peer discussion: prepare two questions for the peers (10%)
- 5) Organization of the presentation (format, delivery, and time management) (20%)

The rest of the students (non-presenters) will write a 1-page summary (1" margin, 12pt Arial, single spaced) and critique of each article (50 points), due at the beginning of the class during which the article will be presented (the presenter does not need to submit the 1-page summary for the paper he/she presents). The final grade of this part will be determined as the average of all the student's non-presenter assignments.

The grading will be based on:

- 1) Identification of knowledge gap, hypothesis, methods, and key results (30%)
- 2) Identification of one significant pitfall of the study (30%)
- 3) Listing one significant follow-up research question not mentioned in the paper (30%)
- 4) Formatting and delivery (10%)

Final Project (100 points): Each student will be asked to write a research proposal based on their assigned papers, or any other topics in cancer and immune system (e.g. based on one of the lecture topics or research cases that interests them), and provide a thorough analysis at both engineering 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. The final proposal will be 6 pages, with 1" page margin, 12pt Arial font, single line spacing. The grading for the final project will be in three parts: specific aims, presentation, and final proposal. The specific aims are due at 12pm on the date specified in the syllabus, and the final proposal will be due at the University-scheduled time of the final exam.

For specific aims (20 points), the grade will be based on:

- 1) Identification of the knowledge gap (25%)
- 2) Relevance and testability of the hypothesis (25%)
- 3) Specificity and relevance of the aims to the hypothesis (25%)
- 4) Independence and synergy between aims (25%)

Presentations (40 points): Students will be asked to present their final project in 25 minutes presentation + 5 minutes Q&A. The grading includes:

- 1) Quality of the presentation (evaluation by Prof. Shen (25 points) and peers (10 points)), based on:
 - a. Significance and problem statement (25%)
 - b. Scientific quality, relevance, and feasibility of the approach (25%)
 - c. Delivery of the presentation (20%)
 - d. Response to critiques and questions from the audience (20%)
 - e. Time management (10%)
- 2) Quality of the peer critiques written by the students to the presenters (5 points) (evaluated by Prof. Shen):
 - a. Are the questions scientifically critical? (75%)
 - b. Are the questions fair and not personal? (25%)

Final proposal (40 points), the grade will be determined by:

- 1) Introduction of the background and significance (30%)
- 2) Logical link between background and hypothesis/aims (30%)

- 3) Novelty, relevance and feasibility of research plan (20%)
- 4) Relevance of the rebuttal to the peer critique questions and comments (10%)
- 5) Language, formatting and delivery (10%)

Grading Breakdown

Assignment	Points	% of Grade
Homework 1~4	100	30
Midterm	100	15
Journal club	100	25
Final proposal	100	30
Total		100

Grading Scale

Final letter grades will be based on the average (AVG) and standard deviation (SD) of the accumulated scores of the class.

Letter Range definition

- A: $\geq \text{AVG} + 1 * \text{SD}$
A-: $\geq \text{AVG}$, but $< \text{AVG} + 1 * \text{SD}$
B+: $\geq \text{AVG} - 1 * \text{SD}$, but $< \text{AVG}$
B: $\geq \text{AVG} - 2 * \text{SD}$, but $< \text{AVG} - 1 * \text{SD}$
B-: $\geq \text{AVG} - 3 * \text{SD}$, but $< \text{AVG} - 2 * \text{SD}$
C: $< \text{AVG} - 3 * \text{SD}$

Assignment Submission Policy

Assignments are due one week after being assigned, at the beginning of the class.

Grading Timeline

Gradings are provided within two weeks of submission.

Additional Policies

Late homework, journal club summaries, and final reports will only be accepted in cases of extreme extenuating circumstances, and permission should be obtained from the instructor before the deadline. Otherwise, points will be reduced by 10% each hour it is late. All the regrading requests for homework or exams are due within one week of their return to the students. The requester must type or write clearly an explanation for the regrade and submit it to Prof. Shen with the original assignment.

Course Schedule: A Weekly Breakdown

(HW: homework; JC: journal club)

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
1/18 1/20	No class (MLK Birthday) Introduction	JC papers assigned	
1/25 1/27	Health and disease Microtechnologies		
2/1 2/3	Micro/nano-technologies Nanotechnologies	HW1 assigned (M)	JC1 (W)
2/8 2/10	Microscopy and single cell techniques I Microscopy and single cell techniques II	HW1 due (M)	JC2 (W)
2/15 2/17	No class (President's day) Materials and surface chemistry		JC3 (W)
2/22 2/24	Animal models Anatomy of grant proposals	HW2 assigned (M)	
3/1 3/3	Cancer I Cancer II	HW2 due (M)	
3/8 3/10	Midterm exam Cancer bioengineering I		JC4 (W)
3/15 3/17	Cancer bioengineering II Cancer bioengineering III		JC5 (M) JC6 (W)
3/22 3/24	Cancer bioengineering IV Cancer bioengineering V	HW3 assigned (M)	JC7 (M); Meetings on aims JC8 (W); Meetings on aims
3/29 3/31	Immune system I Immune system II	HW3 due (M)	
4/5 4/7	Cancer immunity and immunotherapy I Cancer immunity and immunotherapy II		Specific aims due (M) JC9 (W)
4/12 4/14	Immune cell crosstalk and biomanufacturing I Immune cell crosstalk and biomanufacturing II	HW4 assigned (M)	JC10 (M) JC11 (W)
4/19 4/21	Engineering adaptive immunity Final presentations I	HW4 due (M)	JC12 (M)
4/26 4/28	Final presentations II Final presentations III		Peer critique due (F)
FINAL			Final proposal + rebuttal due

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, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

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

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention and Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following *protected characteristics*: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

uscса.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.