BENG 499/590: Tissue Engineering

Spring 2017
Credits: 3
TR 3:00 pm - 4:15 pm
Nguyen Engineering Building 2608

Instructor:
Sahar Jafari, PhD
Adjunct Professor
Department of Bioengineering
Office: Nguyen Engineering Building Room 3707
Email: sjafari2@gmu.edu
Office hours: Tuesdays/Thursdays 2:00-3:00 pm and by appointment

Textbook (Required):

Note: Additional reading material will be provided by the instructor as needed.

Course Description:

Tissue Engineering is dynamic and rapidly growing field within Bioengineering. This course is designed to cover fundamental principles of tissue engineering and include cell sourcing, cell/tissue functions, biomaterial science, scaffolds development, tissue fabrication technology, vascularization strategies, and bioreactors for tissue engineering. These topics are at the heart of tissue engineering.

Learning Objectives:

Upon successful completion of this course, the student should be able to:

• Describe the concepts of cell and tissue engineering
• Explain basic principles of cell-cell and cell-substrate interactions
• Integrate engineering technologies to design and fabricate tissue constructs
• Explain the relevance of scaffolds and biomaterials in tissue engineering
• Interpret the requirements associated with artificial organ development
• Assimilate and understand literature in the area of tissue engineering
Grading Policy:
In-class activity (10%)
Homework (20%)
Group Projects (25%)
Midterm exams (25%)
Final exam (20%)

Course structure:
The course will consist of two weekly lectures, weekly homework assignments, project (written and oral), and three written exams. Please note that all exams will be closed-book and closed-notes.

Homework:
There will be assigned homework throughout the semester. The homework will be assigned on Wednesdays and will be due the following Wednesdays by midnight. Homework submitted after the due date will be penalized (10% penalty for each day late). No homework will be accepted after one week from the due date.

Group Project:
Groups of 3-4 students will work on a scientific project related to tissue engineering. Project report and presentation will be graded as the second mid-term exam. Details of the group project will be provided in the first class as well as at regular intervals. The deadline to submit the written proposal will be 12 a.m. of the day after the final exam.

In-class Exercises:
Active participation in class has been shown to improve learning and retention. Each lecture will include in-class questions and discussions. Students are expected to actively engage in classroom discussions. Scoring for the in-class exercises is described below. You are expected to attend and prepare for each class. This includes reviewing previously covered material, as well as completing the assigned reading. You are responsible for all material covered in class and in the assigned reading. The amount of student engagement in the class and the student’s attendance in the class will be considered for the score of in-class activity.

Exams:
There will be two midterm exams and one final exam in the class. Please note that all exams will be closed-book and closed-notes. The exams will test your level of comprehension of the material covered in this class. The topics covered in the exams will not be cumulative. The final exam will cover the material covered after the second midterm to the last day of class. Absence from either of the exams will be accepted on an emergency only basis. Please contact me at sjafari2@gmu.edu as soon as possible in the event that you will not be able to attend the scheduled exams.
# Course outline

<table>
<thead>
<tr>
<th>Date</th>
<th>Reading Assignment</th>
<th>Topic</th>
<th>Assignments and deadlines</th>
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<tbody>
<tr>
<td>24 Jan</td>
<td>Chapter 1</td>
<td>Tissue Engineering Introduction and Basics</td>
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<tr>
<td>26 Jan</td>
<td>Chapter 1</td>
<td>Design principles and Building Blocks of Tissue Engineering</td>
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<td>31 Jan</td>
<td>Chapter 1</td>
<td>2D VS 3D Artificial Tissue and Organs,</td>
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<tr>
<td>2 Feb</td>
<td>Chapter 2</td>
<td>Cell signaling and functions</td>
<td>Homework #1 Assigned</td>
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<tr>
<td>7 Feb</td>
<td>Chapter 2</td>
<td>Cell-cell interactions</td>
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<tr>
<td>9 Feb</td>
<td>Chapter 2</td>
<td>Cell sources, culture and transplantation</td>
<td>Homework #1 Due</td>
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<tr>
<td>14 Feb</td>
<td>Chapter 2</td>
<td>Stem cells and cell differentiation</td>
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<td>16 Feb</td>
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<td>Exam 1</td>
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<tr>
<td>21 Feb</td>
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<td>Biomaterials introduction</td>
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<tr>
<td>23 Feb</td>
<td>Chapter 3</td>
<td>Biomaterials, classification and characteristics</td>
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<td>28 Feb</td>
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<td>Biomaterials properties</td>
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<td>2 Mar</td>
<td>Chapter 3</td>
<td>Extracellular matrix, cell adhesion and migration</td>
<td>Homework #2 Assigned</td>
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<td>7 Mar</td>
<td>Chapter 3</td>
<td>Smart materials</td>
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<tr>
<td>9 Mar</td>
<td></td>
<td>Microscopy in Tissue engineering</td>
<td>Homework #2 Due</td>
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<td>14 Mar</td>
<td>No Class</td>
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<td>Spring Break</td>
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<tr>
<td>16 Mar</td>
<td>No Class</td>
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<td>Spring Break</td>
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<tr>
<td>21 Mar</td>
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<td>Exam 2</td>
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<td>23 Mar</td>
<td>Chapter 4</td>
<td>Tissue fabrication technologies</td>
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<tr>
<td>28 Mar</td>
<td>Chapter 4</td>
<td>Cell and Organ Printing</td>
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<tr>
<td>30 Mar</td>
<td>Chapter 4</td>
<td>Soft Lithography and cell patterning</td>
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<td>4 Apr</td>
<td>Chapter 4</td>
<td>Artificial organ development through decellularization,</td>
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<td>6 Apr</td>
<td>Chapter 5</td>
<td>Angiogenesis and Vascularization</td>
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<tr>
<td>11 Apr</td>
<td>Chapter 5</td>
<td>Vascularization of artificial tissue</td>
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<td>13 Apr</td>
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<td>Guest Lecture</td>
<td>Homework #3 Assigned</td>
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18 Apr | Presentations
20 Apr | Presentations
25 Apr | Chapter 5 | Biologically inspired vascularization strategies
27 Apr | Chapter 6 | Bioreactors: classification and design aspects
2 May | Chapter 9 | Liver tissue engineering
4 May | Final Exam

**Academic Honesty and Collaboration:**

The integrity of the University community is affected by the individual choices made by each of us. GMU has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct.

With collaborative work, names of all the participants should appear on the work. Homework problems are designed to be undertaken independently. You may discuss your ideas with others and conference with peers; however, it is not appropriate to give your work to someone else to review. You are responsible for making certain that there is no question that the work you hand in is your own. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently.

Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be properly cited. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting.

There will be a zero tolerance policy in this course for plagiarism and cheating in the written project report, in homework submissions, and in take home exam. Every instance of plagiarism or cheating will be reported to the GMU Honor Committee. No excuses. No exceptions. If you have any doubts about what constitutes plagiarism, please see the instructor. **The sanction for an Honor Committee violation on an exam in this class will be a straight F.**

**Email Policy:**

You must use your Mason email account for all email correspondence having anything to do with your work at Mason. Federal laws protecting your privacy rights require that we only communicate student information directly to students – and use of the university email system is our only way to validate your identity. You may forward your campus email elsewhere, but we can respond only to a Mason email account.
Relevant Campus and Academic Resources:

Disability Services
Any student with documented learning disabilities or other conditions that may affect academic performance should: 1) make sure this documentation is on file with the Office of Disability Services (SUB I, Rm. 2500; 703-993-2474; http://ods.gmu.edu) to determine the accommodations you might need; and 2) talk with the instructor to discuss reasonable accommodations.

Office of Diversity, Inclusion and Multicultural Education
SUB I, Rm. 2400; 703-993-2700; https://odime.gmu.edu

Writing Center
Robinson 114A; 703-993-1200; http://writingcenter.gmu.edu

WAVES: Wellness, Alcohol and Violence Education and Services:
WAVES promotes wellness within the Mason community through health education, alcohol/drug assessment and education, and violence awareness, prevention and sexual assault response. We help students make healthy, safe choices and encourage lifelong, thoughtful healthy decision-making through individualized support, creative programming, and evidence-based education and outreach.

WAVES office 703-993-9999
SUB I, Suite 3200
24-Hour Sexual and Intimate Partner Violence Crisis Line 703-380-1434
waves.gmu.edu

- 703-360-7273 (Fairfax County Office for Women and Domestic and Sexual Violence Services 25 hotline)
- 703-228-4848 (Arlington County Domestic Violence Services Hotline)
- 703-368-4141 (Prince William County Sexual Assault Victims Advocacy Services (SAVAS) hotline)
- 1-800-838-8238 (Virginia Family Violence and Sexual Assault Hotline)
- 1-800-656-HOPE (Rape, Abuse and Incest National Network)
  https://ohl.rainn.org/online/

CAPS: Counseling and Psychological Services:
Counseling and Psychological Services (CAPS) provides a wide range of free confidential services to students, faculty, and staff. Services are provided by a staff of professional clinical psychologists, social workers, counselors, learning specialists, and psychiatric providers. CAPS individual and group counseling, workshops, and outreach programs are designed to enhance students’ personal experience and academic performance. Visit us at caps.gmu.edu for additional resources.

- For consultation or emergency assistance during office hours call 703-993-2380.
- For assistance during non-office hours, call University Police at 703-993-4357.
- 703-527-4077 (CrisisLink)
Student Health Services (SHS):
Provides confidential health care to enrolled students in emergency and non-emergency circumstances on the Fairfax, Arlington and Prince William campuses. If there is a medical emergency and Student Health Services (SHS) is closed, please contact the free after-hours nurse ((703) 993-2831), a hospital emergency room, an urgent care facility, or call 911.

SUB 1, Suite 2300
703-993-28319

University Police:
Emergency: 911  Non-Emergency: (703) 993-2810
Reporting a Crime (Crime Solvers Anonymous Tip Hot-Line): (703) 993-4111
Mason Police Website: http://police.gmu.edu/
Eric Heath, Chief of Police  Phone: (703) 993-3840  E-mail: eheath2@gmu.edu