ME696 Tissue Engineering

COURSE INFORMATION

Course Instructor: Dr. Parag Katira
Class Location: E201
Class Days: MW
Class Times: 5.30 to 6.45 pm
Office Hours Location: E211
Email: pkatira@mail.sdsu.edu
Office Hours Times (and by appointment): W 1-3 pm

Course Overview

Course Description: Introduction to the interdisciplinary field of tissue engineering. Application of knowledge of systems engineering, mechanics and materials towards understanding, controlling, and enhancing the performance of biological tissues.

Course Objective: This course will go into the details of how biological tissues function, the critical factors required to maintain and regulate these functions, and the consequences of breakdown of these regulatory systems on tissue performance and human health. Building on this understanding, the students will learn how principles of systems engineering, fluid mechanics, materials science and biomechanics can be applied to influence, rectify and even enhance tissue function. Students will also study the various strategies that are applied to mimic tissue architecture and function in lab built systems for biomedical applications. Finally, the students will get an overview of the ultimate goals of tissue engineering and some of the major challenges currently faced by researchers in this field.

Course Outcomes: On successfully completing the course you will be able to:

1) Learn to apply fluid mechanics, transport phenomena and reaction kinetics to study intra & inter cellular signaling.
2) Learn to apply principles of mechanics to study cell migration, cell-cell interactions, cell-material interactions, and tissue mechanics.
3) Learn to apply statistical modeling to study cell population dynamics and tissue organization.
4) Learn about modern nano and microscale manufacturing techniques to build synthetic tissue environments for in vitro cell growth and artificial organs.
5) Learn to read and review scientific literature in the area of tissue engineering.
6) Learn to formulate impactful research questions and propose an approach to answer them.

Enrollment Information

- Prerequisites: MSBE or MSME student in good standing

Course Materials

The following texts will be used for reference purposes –


Students will require to have access to the online and offline library resources which provides access to a large number of scientific journals some of the reference texts mentioned above.

**Course Structure and Grading**

Tentative course schedule –

<table>
<thead>
<tr>
<th>Date</th>
<th>Content</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/29</td>
<td>Introduction to syllabus</td>
<td></td>
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<tr>
<td>08/31</td>
<td>Transport Phenomena Review – Fluid Flow &amp; Diffusion</td>
<td></td>
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<tr>
<td>09/05</td>
<td>Transport Phenomena Review – Diffusion &amp; Osmotic flow</td>
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<tr>
<td>09/07</td>
<td>Transport between cells and in tissues</td>
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<tr>
<td>09/12</td>
<td>Biomaterials Intro - Polymers</td>
<td></td>
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<tr>
<td>09/14</td>
<td>Biomaterials Intro – Non-polymeric materials such as metals and granular media</td>
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<tr>
<td>09/19</td>
<td>Design of scaffolds and tissue substrates</td>
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<tr>
<td>09/21</td>
<td>Biomechanics Intro – Cell and Tissue Mechanics</td>
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<tr>
<td>09/26</td>
<td>Biomechanics Intro – Cell Adhesion to other cells and substrates</td>
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<tr>
<td>09/28</td>
<td>Biomechanics Intro – Cell Migration</td>
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<tr>
<td>10/3</td>
<td>Biomechanics Intro – Mechanosensing and Mechanotransduction</td>
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<tr>
<td>10/5</td>
<td>Cell Population Dynamics – Growth curves and homeostasis</td>
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<tr>
<td>10/10</td>
<td>Review and Tissue Engineering Ethics??</td>
<td>Might be used to discuss white paper topics</td>
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<tr>
<td>10/12</td>
<td>Exam 1.</td>
<td>20% credit</td>
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<tr>
<td>10/17</td>
<td>Stems Cells as Building Blocks - Fundamentals</td>
<td></td>
</tr>
<tr>
<td>10/19</td>
<td>More Stem Cells - Applications</td>
<td></td>
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Course Grading

Homework – Homework will be assigned at the end of each class, to be turned in before the next class. (40% credit)

Exam – There will be one exam testing the fundamentals of tissue engineering related transport phenomena, biomechanics, biomaterials and growth modeling and characterization (20% credit).

White papers – Students will also work with their groups of 3 on identifying an important unsolved problem in tissue engineering and work towards developing a potential approach to solve it. They will propose their findings in the format of a five page white paper where they will describe the problem, its significance, their hypothesis/approach and its justification based on what they have learnt so far in class, proposed work, and potential outcomes. (30% credit + 10% credit for peer review)

Potential areas for research may include

1) Drug Delivery
2) Embryogenesis
3) Wound healing
4) Tissue regeneration
5) Artificial Tissue
6) Stem Cells and Genetic Engineering
Students with Disabilities

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services. Your cooperation is appreciated.

Academic Honesty

The University adheres to a strict policy regarding cheating and plagiarism. These activities will not be tolerated in this class. Become familiar with the policy (http://www.sa.sdsu.edu/srr/conduct1.html). Any cheating or plagiarism will result in failing this class and a disciplinary review by Student Affairs.

Examples of Plagiarism include but are not limited to:

- Using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work)
- Copying and pasting work from an online or offline source directly and calling it your own
- Using information you find from an online or offline source without giving the author credit
- Replacing words or phrases from another source and inserting your own words or phrases
- Submitting a piece of work you did for one class to another class

If you have questions on what is plagiarism, please consult the policy (http://www.sa.sdsu.edu/srr/conduct1.html) and this helpful guide from the Library: (http://infodome.sdsu.edu/infolit/exploratorium/Standard_5/plagiarism.pdf)

Turnitin

Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. You may submit your papers in such a way that no identifying information about you is included. Another option is that you may request, in writing, that your papers not be submitted to Turnitin.com. However, if you choose this option you will be required to provide documentation to substantiate that the papers are your original work and do not include any plagiarized material.

Interacting with me

I will assign two full hours of office hours. Please use this time to come talk to me regarding any questions, concerns and suggestions you might have. If you really need to talk to me but cannot make it to office hours, please email me to schedule a meeting time. Queries submitted via email may or may not receive a timely response based on the severity of the issue, the brevity of the response required and the ease of finding the answer elsewhere (such as by consulting the course syllabus).