BME 160 TISSUE ENGINEERING
(Required for BME and BMEP)

Catalog Data: **BME 160 Tissue Engineering (Credit Units: 4)** Quantitative analysis of cell and tissue functions. Emerging developments in stem cell technology, biodegradable scaffolds, growth factors, and others important in developing clinical products. Applications to bioengineering design. Prerequisites: BME50A-B, BME121. (Design units: 2)

Textbook: Palsson, Bernhard O., Bhatia, Sangeeta. *Tissue Engineering*. Pearson Prentice Hall, 2004 ISBN # 0-13-041696-7
Supplemental Reading: An additional 1-2 articles each week will be posted on the course website at: http://eee.uci.edu. These are required reading and will be discussed in lectures.

References: Alberts, *Molecular Biology of the Cell*.
Patrick et al., *Frontiers in Tissue Engineering*.
Lanza, Chick, Langer, *Principles of Tissue Engineering*.
Ratner, Hoffman, Schoen, Lemons, *Biomaterials Science*.

Coordinator: Andrew J. Putnam

Relationship to Program Outcomes: This course relates to the Program Outcomes for:
BME: a, e, g, i, j, and k as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/biomedical/mission

Course Outcomes / Performance Criteria: Students will:
Read, discuss, and critique recent publications from the tissue engineering literature. (BME i, j)
Choose (and tailor as needed) a biomaterial scaffold suitable for use in a specific engineered tissue application.)(
Provide a theoretical design for an effective tissue engineering strategy as a potential solution to a specific disease or condition.
Prepare a mock grant proposal that resembles an NIH or an NSF format.
Summarize (both written and orally) the importance of the extracellular matrix, cell signaling, biomechanics, biocompatibility, mass transport, and vascularization in the successful development of engineered tissues.

Prerequisites By Topic: Cell and molecular engineering.
Quantitative physiology: sensory motor systems.

Lecture Topics: Overview of tissue engineering.
Tissue organization, morphogenesis, and remodeling.
Sources of cells and cell culture.
Extracellular signaling/regulation of cell fate.
Biomaterial scaffold design.
Biocompatibility and immunology.
Biomechanics and mechanotransduction.
Mass transport and strategies for vascularization.
Growth factor and gene delivery

Case studies in tissue engineering.
Discussions on relevant literature papers.
Student presentations of mock grant proposals.

Class Schedule: Meets for 3 hours of lecture and 1 hour of discussion each week for 10 weeks.

Computer Usage: MS Word usage required for preparation of final project

Laboratory Projects:

Professional Component: Contributes toward the Biomedical Engineering Topics and Major Design experience.

Design Content Description

Approach: Students will organize into groups of 3-4 students and prepare a mock grant proposal (typical NIH or NSF format) designed to engineer a specific tissue in the human body. The engineered tissue must be clinically relevant (i.e., provide a potential solution to a specific disease or condition), and the proposal should clearly build on the existing literature. The design MUST include some aspect of the course, such as the use of a biodegradable scaffold, the design of a bioreactor capable of applying mechanical loads to an engineered tissue, growth factor delivery, biomechanical analysis of the engineered tissue, etc. Grant writing guidelines will be provided at a later date. In addition to a written proposal (approximately 15-20 pages), teams will prepare 15-20 minute presentations of their design to be presented in front of their peers during the last week of the quarter. (75%)
Strategies for engineering functional tissues based on rational design and biomimetics are emphasized throughout the course, including topics on synthetic ECM analogs, mass transport/vascularization, and growth factor and gene delivery. (25%)
Lectures: Strategies or engineering *functional* tissues based on rational design and biomimetics are emphasized throughout the course, including topics on synthetic ECM analogs, mass transport/vascularization, and growth factor and gene delivery.100%
Laboratory Portion: 0%

Grading Criteria:

Midterm exam:	30%	
Final exam:	30%	
<u>Final project:</u>	<u>40%</u>	(10% for oral presentation)
Total	100%	

Estimated ABET Category Content:

Mathematics and Basic Science: <u>0</u> credit units or <u>0%</u>
Engineering Science: <u>2</u> credit units or <u>50%</u>
Engineering Design: <u>2</u> credit units or <u>50%</u>

Prepared by: <u>Andrew J. Putnam</u> **Date:** <u>July 2007</u>

CEP Approved: <u>Fall 2002</u>