BMEH110A HONORS BIOMECHANICS I
(Elective for BME and BMEP)

Catalog Data: **BMEH110A Honors Biomechanics I (Credit Units: 4)** Covers the same material as BME110A-B but in greater depth. Prerequisites: Physics 7D, 7LD. 7E and admission to Campuswide Honors Program. BMEH110A-B and BME110A-B may not both be taken for credit. (Design Units: 1)

Textbook: Fung, Y. C., *A First Course in Continuum Mechanics for Physical and Biological Engineers and Scientists*., 3rd edition, Prentice Hall, New Jersey, 1994.

References:

Coordinator: Elliot Botvinick

Relationship to Program Outcomes: This course relates to Program Outcomes
BME: a, b, c, e, and k as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/biomedical/mission

Performance Criteria/Course Outcome: Students will:
Describe the continuum hypothesis.(BME a)
Describe Newton's Laws of motion qualitatively and quantitatively. (BME a)
Express physical laws using index notation. (BME a)
Use free body diagrams to analyze the distribution of forces in a structure. (BME a)
Solve equilibrium problems using resultant forces and moments. (BME a)
Define stress, principal stress, stress deviator, stress boundary conditions and Cauchy's relation. (BME a)
Describe the equation of equilibrium and use it to solve various problems. (BME a)
Define strain, rotations, and spin tensor. (BME a)
Describe the constitutive relation of solid, fluid and gas. (BME a)
Describe the conservation laws: mass, momentum and energy. (BME a).
Define the Reynolds Number. (BME a)
Solve the problem of flow between two parallel channels. (BME a)
Solve the problem of flow in a tube (Poiseuille's equation). (BME a)
Develop simple models of viscoelastic tissues. (BME b)
Use knowledge of continuum mechanics to formulate and solve various other problems of solids and fluids. (Homework and design projects).(BME c, k)
Study existing and design novel biomechanical devices. (BME e)

Prerequisites By Topic: Understanding of classical physics in electricity, magnetism, fluids, oscillations, waves and optics; calculus and differential equation.

Lecture Topics: Newton's laws of motion, index notation, resultant forces, moments.
Free body diagrams, orthogonal transformations.
Definition of stress, Cauchy relation, equation of equilibrium, applications.
Principal stresses, stress deviator, stress boundary conditions.
Infinitesimal strains, rotations, spin tensor, compatibility.

Theory of deformation, strain, strain rate, geometric interpretation.
Material properties, solids, fluids, Newtonian incompressible fluids .
Material derivatives, conservation of mass of a continuum.
Equation of motion for a fluid, Navier-Stokes equations, non-dimensionalizations, Reynolds number.
Applications: flow between parallel channels, flow in a tube (Poiseuille's equation).

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

Computer Usage:

Laboratory Projects:

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

Design Content Description

Approach: Specific discussions on biomechanical system designs. (30%) Students will use learned skills to analyze and design mechanical systems to model biological systems. (70%)
Lectures: 100%
Laboratory Portion:

Grading Criteria:

Homework assignments:	25%
Midterm exam I:	20%
Midterm exam II:	20%
Final exam:	35%
	100%

Estimated ABET Category Content:

Mathematics and Basic Science: 0 credit units or 0%
Engineering Science: 3 credit units or 75%
Engineering Design: 1 credit units or 25%

Prepared by: Elliot Botvinick **Date:** July 2008

CEP Approved: Fall 2005