BMEH110A HONORS BIOMECHANICS I

Catalog Data: **BMEH110A Honors Biomechanics I (Credit Units: 4) F.** Covers the same material as BME110A-B but in greater depth. [Introduction to continuum mechanics of both living and nonliving systems. Laws of motion and free body diagrams. Stresses, deformation, compatibility conditions, and constitutive equations. Properties of common fluids and solids. Field equations and boundary conditions. Applications to bioengineering designs.] 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: None.

Coordinator: James P. Brody.

Course Outcomes: Students will be able to:
Describe the continuum hypothesis, Newton's Laws of motion qualitatively and quantitatively.
Express physical laws using index notation.
Use free body diagrams to analyze the distribution of forces in a structure.
Solve equilibrium problems using resultant forces and moments.
Define stress, principal stress, stress deviator, stress boundary conditions and Cauchy's relation.
Apply the equation of equilibrium to solve various related problems.
Define strain, rotations, and spin tensor.
Describe the constitutive relation of solid, fluid and gas.
Describe the conservation laws: mass, momentum and energy.
Non-demensionalize the Navier-Stokes equation.
Define the Reynolds Number.
Solve the problem of flows between two parallel channels and in a tube (Poiseuille's equation.
Apply the knowledge of continuum mechanics to formulate and solve various other problems of solids and fluids.

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: Each class meets 3 hours per week for 10 weeks and students are assigned to a 1 hour discussion session per week.

Computer Usage: None.

Laboratory Projects: None.

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

Relationship to Program Outcomes: This course relates to Program Outcomes 1, 2, and 4 as stated at: http://www.eng.uci.edu/dept/objective_biomedical.

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: James P. Brody **Date:** July 2005

CEP Approved: Fall 2005

Effective Date: Fall 2005