BMEH110B HONORS BIOMECHANICS II

Catalog Data: **BMEH110B Honors Biomechanics II (Credit Units: 4) W.** 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.] Prerequisite: BME H110A BMEH110A-B and BME110A-B may not both be taken for credit. (Design Units: 1)

Textbook: Fung, Y. C., Biomechanics*: Mechanical Properties of Living Tissues.,* 2nd edition, Springer Verlag: New York, 1993.

References: None.

Coordinator: James P. Brody.

Course Outcomes: Students will be able to:
Describe the continuum model, a tensor, and the constitutive equations for biological solids and fluids.
Describe the constitutive relation of solid, fluid and gas.
Express physical laws using index notation.
Use free-body diagrams to analyze the distribution of stresses in a structure.
Apply the equation of equilibrium to solve various problems; to solve for the velocity profile for blood in a vessel.
Describe the conservation laws: mass, momentum and energy.
Non-dimensionalize the Navier-Stokes equation.
Describe the rheology of blood, the effects of red blood cells and blood clotting.
Simplify the Navier-Stoke's equation for flow in the microcirculation.
Describe non-Hookean elastic solids.
Apply the knowledge of biomechanics to formulate and solve various other problems of solids and fluids.

Prerequisites By Topic: Understanding of continuum mechanics of both living and nonliving bodies, properties of common fluids and solids, and derivation of field equations and boundary conditions.

Lecture Topics: Biomechanics: the continuum mechanics model, experiment and design.
Review of matrices, vectors and tensors, tensor analysis and kinematics: motion and strain.
Stress and equilibrium.
Constitutive equations for biological solids and fluids, the properties of blood and plasma, viscosity and its measurement.
The flow of blood in a tube. Navier-Stokes equations.
Rheology of the whole blood, the effects of red blood cells, clotting.
Blood flow in microcirculation, red blood cells in very narrow tubes, bioviscoelastic fluids.
Elasticity, Hookean and non-Hookean elastic solids.

Red blood cell deformability and testing, elasticity of the red blood cell membrane.
The mechanics of bone and skeleton, mechanical properties of cartilage, testing methods.

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

Lectures: 100%

Laboratory Portion:

Grading Criteria:

Homework assignments:	30%
Midterm exams:	30%
Final exam:	40%
	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