Course Profile: Biomedical Engineering Program

COURSE #: BIOMEDE 332	**COURSE TITLE:** INTRODUCTION TO BIOSOLID MECHANICS
TERMS OFFERED: Winter	**PREREQUISITES:** Biomede 231
TEXTBOOKS/REQUIRED MATERIAL: Web-based notes provided by Instructor	**COGNIZANT FACULTY:** Hollister **DATE OF PREPARATION:** 9/30/2004
INSTRUCTOR(S): Hollister	**SCIENCE/DESIGN:** 4
CATALOG DESCRIPTION: This course covers the fundamental of continuum mechanics and constitutive modeling relevant for biological tissues. Constitutive models covered include linear elasticity, nonlinear elasticity, viscoelasticity and poroelasticity. Structure-function relationships which link tissue morphology and physiology to tissue constitutive models will be covered for skeletal, cardiovascular, pulmonary, abdominal, skin, eye, and nervous tissues.	**COURSE TOPICS:** 1. Index Notation, Vectors, and Tensors 2. Continuum Mechanics Concepts of Stress, Strain and Momentum Balance 3. Determination of Boundary Conditions 4. Constitutive Models: Linear/Nonlinear Elasticity, Viscoelasticity, Poroelasticity 5. Skeletal Tissue (bone, cartilage, ligament/tendon) Structure-Function 6. Cardiovascular Tissue (blood vessel, heart valve, heart muscle) Structure-Function 7. Pulmonary/Abdominal (lung, kidney, liver) Structure-Function 8. Skin, Nerve, Eye Structure-Function

COURSE OBJECTIVES	Links shown in brackets are to the departmental educational objectives. 1. Teach students basic ideas of index notation, vectors and tensors for use in continuum mechanics [1,11]. 2. Have students understand concepts of continuum mechanics including stress, small/finite strain, momentum balance [1,11]. 3. Teach students constitutive models including linear and nonlinear elasticity, viscoelasticity and poroelasticity that are relevant for biological tissues. [1,11]. 4. Teach students how boundary conditions are developed for biological tissue mechanics problems [1,11,13]. 5. Teach students the concept of structure-function relationships for biological tissues. Specifically, how tissue morphology and physiology are related to constitutive models and how changes in tissue structure due to disease can be reflected in constitutive models [1,5,11,13]. 6. Introduce students to what experiments and data processing are done to develop constitutive models [1,2,11,13]. 7. Teach students how structure-function relationships may be used to characterize how disease and remodeling affect tissue function [7].
COURSE OUTCOMES	Links shown in brackets are to the course objectives. 1. Learn how to use index notation, vectors and tensors as a way to write continuum mechanics problems [1]. 2. Understand the concepts of stress, finite strain and equilibrium [2]. 3. Understand constitutive equations, how they are applied to materials and their limitations [3,5,6] 4. Learn how to use numerical modeling techniques to solve optimization problems to determine boundary conditions [4] 5. Learn how multilevel tissue morphology is related to tissue function as described by constitutive models [3,6]. 6. Learn how experiments coupled with modeling are used to develop constitutive equations [3,7].
ASSESSMENT TOOLS	Links shown in brackets are to the course outcomes. 1. Graded homework assignments [1-6]. 2. Written examinations (two midterm exams and one final exam) [1-6]. 3. End of term course evaluations by each student [1-6].