ENG ME 524/BE 524/MS 524 Skeletal Tissue Mechanics

2008-2009 Catalog Data:

ENG ME 524/BE 524/MS 524 Skeletal Tissue Mechanics Prereq: ENG EK 301, ENG ME 302, ENG ME 305, ENG ME 309, and CAS MA 242 or equivalent. The course is structured around classical topics in mechanics of materials and their application to study of the mechanical behavior of skeletal tissues, whole bones, bone-implant systems, and diarthroidal joints. Topics include: mechanical behavior of tissues, (anisotropy, viscoelasticity, fracture, and fatigue) with emphasis on the role of the microstructure of these tissues; structural properties of whole bones and implants (composite and asymmetric bean theories); and mechanical function of joints (contact mechanics, lubrication, and wear). Emphasis is placed on using experimental data to test and to develop theoretical models, as well as on using the knowledge gained to address common health-related problems related to aging, disease, and injury. Students may not receive credit for both ME 524 and BE 524. 4 cr.

Class/Lab Schedule: 4 hours of lecture per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: "Skeletal Tissue Mechanics" by R.B. Martin, D.B. Burr, and N.A. Sharkey, Springer-Verlag, 1998

Coordinator: Elise Morgan, Assistant Professor, Mechanical Engineering

Prerequisites by topic:

1. Undergraduate-level understanding of the mechanics of rigid bodies, stress and strain, beam theory, matrix algebra

Goals:

1. Provide a rigorous education in the application of mechanics principles to biological tissues
2. Provide training in incorporating knowledge of tissue material properties in structural analyses of bones, joints, and bone-implant systems
3. Provide examples of the state-of-the-art in skeletal tissue mechanics
4. Convey an appreciation of the role of mechanics in multidisciplinary study of the skeletal system

Course Learning Outcomes:

As an outcome of completing this course, students will:

i. Appreciate the importance of proper mechanical function of skeletal tissues
ii. Understand the correspondence between the microstructure and mechanical behavior of skeletal tissues
iii. Have exposure to incorporating microstructural information in continuum descriptions of material behavior

iv. Understand how to test the suitability of a constitutive theory for a given material
v. Understand how to incorporate material/tissue constitutive behavior in analyses of whole bones, joints, and orthopaedic implants
vi. Appreciate the challenges of proper design of experiments for measuring the material properties of biological tissues and the structural properties of whole bones and bone-implant systems
vii. Understand the advantages and disadvantages of computer modeling techniques for solving problems in biomechanics
viii. Present their work in a clear, succinct manner in both oral and written formats

Course Learning Outcomes mapped to Program Outcomes:

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i-viii	ii-iv,vi,vii	v		ii-viii	vi, vii	viii	i	i, viii	i, v, vii	i-viii			
Emphasis:	5	5	3	1	5	2	4	5	3	4	5	1	1	1

Topics (time spent in weeks):
1. Mathematical Preliminaries, Basic Anatomy, Static Analysis of Muscle and Joint Forces (1.5)
2. Anisotropic Elasticity (1)
3. Viscoelasticity (1)
4. Poroelasticity and Mixture Theories (2)
5. Damage, Fracture, and Fatigue (2)
6. Asymmetric Bending (1)
7. Composite Beam Theory (1)
8. Contact Mechanics (1)
9. Lubrication and Wear (1)
10. Mechanical Adaptation of Skeletal Tissues (1)
11. Student Project Presentations (1)

Contribution of Course to Meeting the Professional Component:
Engineering topics: 100%

Prepared by: Elise Morgan **Date**: 4/1/09