TO: The Engineering Faculty
FROM: Department of Biomedical Engineering
RE: New Graduate-Level Course

The Department of Biomedical Engineering has approved the following new course. Approval of the Faculty of the Schools of Engineering is requested.

BME 540 Biomechanics

A. Course Description

Sem. 2. Class 3, cr. 3.

Prerequisites: Statics, dynamics, differential equations, and solid mechanics (strengths of material), or by permission of instructor.

Application of engineering mechanics to the study of normal and diseased musculoskeletal systems, including bone and soft tissue biology, musculoskeletal statics and dynamics, mechanical properties of biological tissues, and structural analysis of bone-implant systems.

B. Reason: This course has been offered two times on an experimental basis and has received high interest from both undergraduate (7, 8, 7) and graduate (4, 11, 7) students representing various engineering departments. This course is taught from a quantitative perspective and is geared towards engineering students, but also provides students with a strong foundation of musculoskeletal biology and clinical case studies. This course was offered in Spring 2001, Spring 2002 and Spring 2003 with 11, 19, 14 respectively.

George R. Wodicka
Professor and Head
Department of Biomedical Engineering

Supporting Documentation:

Course Instructor: Karen Haberstroh

Course Objective: This course focuses on the mechanical design of organisms, specifically dealing with the application of mechanics to the study of normal and diseased musculoskeletal systems. Select areas to be covered include determination of joint and muscle forces, mechanical properties of biological tissues (including bone and soft tissues such as cartilage, tendon, and meniscus), mechanical properties of bone and bone fatigue/failure, structural analysis of bone-implant systems, and soft tissue biomechanics (including viscoelasticity). Case studies and problem solving sessions will be used to emphasize the unique biological criteria which must be considered in biomechanical engineering and implant design.

Student Population: The student population will consist of advanced undergraduate students (seniors) and graduate students from various engineering disciplines. Non-engineering students will also be encouraged to enroll in this course; however, the course will be strictly taught from a quantitative perspective. Prerequisite courses have been provided for all students; supplementary reading material will be provided to those students who feel deficient in certain topical areas of the course.

Course Format: This course is lecture based. Time in each classroom session will be dedicated to group problem solving (for example, using case studies).

Course Content:

Lecture	Topic
1	Biomechanics: Introduction
2	Musculoskeletal Force Equilibrium
3	Musculoskeletal Force Distribution: Reduction, Linear and Non-Linear Optimization
4	Musculoskeletal Dynamics: Kinematics and Kinetics (1)
5	Musculoskeletal Dynamics: Kinematics and Kinetics (2)
6	Gait Analysis: Force Plate Studies (1)
7	Gait Analysis: Force Plate Studies (2)
8	Gait Analysis: Pressure Distribution Studies
9	**EXAM 1**
10	Bone Physiology
11	Mechanical Properties of Bone: Axial Loading
12	Mechanical Properties of Bone: Bending Loads

13 Mechanical Properties of Bone: Torsional Loading, **Abstracts Due**
14 Bone Fatigue and Fracture Risk
15 Orthopaedic Implant Design: Elastic Properties of Metals in Bone
16 Orthopaedic Implant Design: Bone Plates
17 EXAM 2
18 Composition and Structure of Articular Cartilage, Meniscus, Tendons, and Ligaments
19 Soft Tissue Biomechanics: Constitutive Modeling of Viscoelastic Materials (1)
20 Soft Tissue Biomechanics: Constitutive Modeling of Viscoelastic Materials (2)
21 Soft Tissue Biomechanics: Tension, Compression, and Shear
22 Soft Tissue Biomechanics: Biphasic Creep and Stress Recovery
23 Biomechanics of Tendons and Ligaments: Quasi-Linear Viscoelastic Theory
24 Joint Lubrication
25 Friction and Wear of Joints
26 EXAM 3
27 Class Presentations, Final Papers due
28 **Class Presentations**
29 **Class Presentations**
30 **Special Topic**