TO: The Engineering Faculty

FROM: The Faculty of the Department of Biomedical Engineering

RE: New Undergraduate-Level Course

The faculty of the Department of Biomedical Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

BME 202 Biomaterials

Sem. 2. Class 3, cr. 3.

Prerequisite: BME 205, ME 270
Corequisite: BME 206, BME 204

Covers the fundamentals of materials science and engineering concepts in a biological application context. Crystal structure, deformation of materials, characterization of materials, and performance of materials as implants. Integrated biological topics include bone physiology/anatomy, cells of bone, cell structure, and protein-mediated cell attachment. Emphasizes the unique biological criteria which must be considered when designing synthetic materials for implants.

Reason: Introducing students to the wide range of materials and properties which can be used to interact with physiological systems in a biomedical engineering context is important to understand and to develop implantable medical devices.

George Wodicka
Professor and Head

Supporting Documentation:

1. Level: Undergraduate – sophomore year

2. Course Instructor: Thomas J. Webster

3. Course Outline:

Topics in order	*Lectures*
Structure (10 lectures):	
– Atomic bonding (1 lecture) / Crystal structure (2 lectures)	*3*
– Atoms of the same size / different size (1 lecture each)	*2*
– Imperfections in crystalline structures	*3*
– Definition of metals / ceramics / long-chain molecular compounds / polymers / Composite material structure	*2*
Processing (6 lectures):	
– Forging, rolling, extrusion, drawing, cold-working / Strengthening grain boundaries	*3*
– Strain aging / Fiber and Martensite strengthening / Annealing and sintering / Strengthening of polymers and elastomers	*3*
Characterization (16 lectures):	
– Stress-strain behavior / Mechanical failure / Tension, compression, and bending tests	*3*
– Hardness, Torsion, Fracture toughness, and Fatigue testing	*2*
– Viscoelasticity	*2*
– Phase diagrams, Surface and Thermal Properties	*3*
– Electrical and Optical properties, X-ray absorption	*3*
– Density, Porosity, Acoustic and ultrasonic properties, and Diffusion	*3*
Biological Applications (9 lectures):	
– Bone biology/physiology, Tissue response to implants	*3*
– Tissue response to implants (cont.), Metallic and Ceramic implant materials	*3*
– Polymeric implant materials, Biological (natural) and Composite materials	*3*
EXAMS	*3*
Total	*44*

4. Text:

Ratner BD, Hoffman AS, Schoen FJ, Lemons JE: Biomaterials Science: An Introduction to Materials in Medicine. Academic Press, New York, 1996.

5. Grading: based on exams, homework, quizzes, and computational assignments.