ENG ME 523/BE 523/MS 523 Mechanics of Biomaterials

2008-2009 Catalog Data:
ENG ME 523/BE 523/MS 523 Mechanics of Biomaterials Prereq: ENG EK 301, ENG ME 305 or ENG BE 420; ENG ME 306 is desirable. Covers the chemical composition, physical structure, and mechanical behavior of engineering polymers. Study of types of polymers; rubber elasticity; fundamentals of viscoelastic phenomena such as creep, stress relaxation, stress rupture, mechanical damping, impact; effects of chemical composition and structure on viscoelastic and strength properties; methods of chemical property evaluation. Fracture and fatigue of polymer materials. Influences of plastics fabrication methods on mechanical properties. Emphasis on recent research techniques and results. Students will complete a semester-long design project. 4 cr.

Class/Lab Schedule: Two 2 hour lectures per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: N. Dowling, "Mechanical Behavior of Materials", 3rd edition.

Coordinator: Catherine Klapperich, Assistant Professor, Mechanical Engineering

Prerequisites by topic:
1. Engineering Mechanics
2. Mechanics of Materials

Goals:
To apply mechanics of materials and the principles of mechanical design to biomedical devices.

Course Learning Outcomes:

As an outcome of completing this course, students will:
i. Know the materials used in medical devices and the general requirements for their use, including biocompatibility considerations.
ii. Know the basics of obtaining FDA approval for a new device (with a focus on mechanical performance and Good Manufacturing Procedures)
iii. Know how to perform a materials selection exercise.
iv. Know how to determine the principal stresses for a multiaxial state of stress.
v. Know how to apply structural mechanics techniques to biomedical devices.
vi. Know how to use failure criteria appropriately.
vii. Know how to perform a total life analysis for a new design.
viii. Know how to use fracture toughness data from experiments to predict device lifetiemes.
ix. Consider the ethical issues that surround medical device design, marketing and quality control.

x. Produce a quality technical drawing of a novel medical device design.
xi. Present work to classmates and other faculty members in a concise and clear manner.

Course Learning Outcomes mapped to Program Outcomes:

Program:	a	b	c	d	e	f	g	h	i	j	k	L	M	n
Course:	ii-viii	i-viii	i-xi	xi	i-xi	ix	xi	ii,ix	ix	ii,ix	x	iv-viii	i	iii-viii
Emphasis:	5	4	5	5	5	3	4	4	3	3	3	4	2	4

Topics (time spent in weeks):
1. Materials Classes (1)
2. Materials Selection Exercises (1)
3. Deformation of Elastic Bodies (1)
4. Complex States of Stress, Principal Stresses (Beam theory review) (1)
5. Linear Viscoelasicity and Failure modes of polymers (2)
6. Failure Criteria
7. Fracture and Fatigue (2)
8. Sterilization and Processing of Medical Devices (and their effects on mechanical properties), Metrology (1)
9. Biocompatibility and Surface Mechanics (1)
10. Presentation of final projects to class (1)

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

Status of Continuous Improvement Review of this Course:
Prepared by: Catherine Klapperich **Date**: 2 April 2009