COURSE PROFILE

Degree Program: Materials Science and Engineering
Prepared by: J. Hyde
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COURSE #: MSE 410	**COURSE TITLE: DESIGN AND APPLICATIONS OF BIOMATERIALS**
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Biomaterials Science: An Introduction to Materials in Medicine*, B.D. Ratner, A.S. Hoffman, F.J. Schoen, J.E. Lemons, 2nd Ed., Elsevier Academic Press, 2004.	**PREREQUISITES: MSE 220 or 250 (E)**
INSTRUCTOR(S): Kim	**COGNIZANT FACULTY: Takayama, Kim, Martin, Lahann, Filisko**
CoE BULLETIN DESCRIPTION: Biomaterials and their physiological interactions. Materials used in medicine/dentistry: metals, ceramics, polymers, composites, resorbable smart, natural materials. Material response/degradation: mechanical breakdown, corrosion, dissolution, leaching, chemical degradation, wear. Host responses: foreign body reactions, inflammation, wound healing, carcinogenicity, immunogenicity, cytotoxicity, infection, local/systemic effects.	**COURSE TOPICS:** 1. Design parameters applicable to biomaterials. 2. Reconstructive materials used in medicine and dentistry (metals, ceramics, polymers, composites). 3. Regenerative materials used in medicine and dentistry (bioresorbable materials, films/coatings, smart materials, natural materials, biologically functional materials) 4. Material response-material degradation in-vivo (deformation/mechanical breakdown, corrosion, dissolution/leaching, chemical degradation, friction/wear). 5. Host responses (foreign body reactions, inflammation, histological/hematological considerations, wound healing, carcinogenicity, immunogenicity, cytotoxicity, infection, local and systemic effects). **6.** Methods of testing material performance (in-vitro and in-vivo methods and models, standardization and retrieval analysis). **7.** Design principles for individual applications (biocompatibility, mechanical properties, cell adhesion properties, protein adhesion properties).
COURSE STRUCTURE/SCHEDULE: Lecture: 4 per week @ 50 minutes each; Laboratory: 1 per week @ 2 hours.	

COURSE OBJECTIVES	1. To teach students the interdisciplinary issues involved in biomaterials design, synthesis, evaluation and analysis, so that they may pursue higher-level, more focused graduate courses in biomaterials, address research problems, or pursue a job-search in the medical device industry. 2. To teach students the basic classes of reconstructive biomaterials and how these materials differ from similar classes of materials used in other industries. 3. To teach students the basic classes of regenerative biomaterials and how combinations of materials and biological moieties may be used in combination to orchestrate a desired physiological response. 4. To teach students mechanisms of material degradation in-vivo and how to apply these concepts to biomaterials design and analysis. 5. To teach students mechanisms of host responses to biomaterials so that these concepts may be used to design and evaluate new and existing biomaterials. 6. To provide students with a greater familiarity with the biomaterials research literature. 7. To provide some training in critical thinking and analysis. 8. To provide some training in (written) communication of scientific and engineering ideas.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcomes are identified.	1. Given a clinical problem involving lost tissue structure and function, students should be able to express a range of potential biomaterial treatments options, including synthetic and/or biological strategies. 2. Given a biomaterial design problem, students should be able to outline all parameters needed to optimize the design. 3. Given a specific biomaterial, students should be able to identify the advantages and disadvantages of this material in terms of its material degradation and host response. 4. Given a specific organ/tissue system in need of reconstruction or regeneration, students should be able to identify appropriate candidate materials a and an appropriate time frame of service-life. 5. Given a specific biomaterial, students should be able to identify the important biological responses of potential importance.

obtained from MSE 6/06

ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. Biweekly, problem sets to test objectives 1) - 5) for individual students (50/450 points). 2. In-class three closed-book exams to test objectives 1) - 5) for individual students – focus on design principles of biomaterials and related biological events (150/450 points). 3. In-class 10-minute presentation on a freely chosen paper related to course topics to test objectives 1) – 5) and help students to develop critical journal reading ability (50-/450). 4. A written proposal and an in-class presentation of a research idea on biomaterial development to test assignment to test objectives 1-5 for groups of students – define a problem in biomaterials, pose research questions/hypotheses and methodologies to address this problem, and write a research proposal to address this question (150/450). 5. In-class participation to encourage interactive discussions (50/450).

Revised: 06 13 06