Course Profile: Biomedical Engineering Program

COURSE #: BIOMEDE 321	**COURSE TITLE:** BIOREACTION ENGINEERING AND DESIGN
TERMS OFFERED: Winter	**PREREQUISITES:** BIOMED 221, BIO 310 (310 can be concurrent)
TEXTBOOKS/REQUIRED MATERIAL: Bioprocess Engineering Basic Concepts, M. L. Shuler and F. Kargi Elements of Chemical Reaction Engineering, H. S. Fogler	**COGNIZANT FACULTY:** Takayama **DATE OF PREPARATION:** 10/22/2004
INSTRUCTOR(S): Takayama	**SCIENCE/DESIGN:** 2/1
CATALOG DESCRIPTION: This course will introduce students to topics in enzyme kinetics, enzyme inhibition, mass and energy balance, cell growth and differentiation, cell engineering, bioreactor design, and analysis of the human body, organs, tissues, and cells as bioreactors. The application of bioreaction/bioreactor principles to tissue engineering will also be discussed.	**COURSE TOPICS:** 1. Enzymes, Enzyme kinetics, and Enzyme inhibition 2. How cells work; Cell growth and differentiation 3. How cellular information is altered 4. Materials and energy balance 5. Bioreactors: Types of reactors and process of operation 6. Microbioreactors 7. Tissue engineering considerations

COURSE OBJECTIVES	Links shown in brackets are to the departmental educational objectives. 1. To train students to understand enzyme structure and function, and be able to analyze enzymatic reactions and enzyme inhibition [1, 14]. 2. To teach students applied cellular and molecular biology concepts [3, 10, 12]. 3. To introduce students to methods of materials and energy balance [1, 3, 5, 13]. 4. To teach how bioreactors are designed and operated [3, 5, 12, 13]. 5. To teach how bioreaction/bioreactor principles apply to formation and function of tissues [10, 12, 13]. 6. To teach students how to work in groups to solve engineering problems in bioreactions and bioreactors [4, 5, 7]. 7. To enhance students' communication skills through oral in-class presentation of contemporary issues in bioreactions/bioreactors [4, 7, 9, 10, 12].
COURSE OUTCOMES	Links shown in brackets are to the course objectives. 1. Be able to derive the Michaelis-Menten equation as well as equations for different modes of inhibition (competitive, etc) [1,6]. 2. Given velocity vs substrate data, make a Lineweaver-Burk plot, calculate Km, Vmax, Ki, and describe mode of inhibition [1,6]. 3. Be able to describe basic steps of how to engineer cells (molecular biology) [1, 2, 6] 4. Use the principles of materials and energy balances to design reactions/media or understand the mechanism of bioreactions [1, 2, 3, 4, 6] 5. Solve problems on cell growth kinetics and product formation [2, 3, 4, 5, 6]. 6. Be able to describe how transport affects cell growth, differentiation, and tissue formation (e.g. oxygen gradient & liver function)[2, 3, 5, 6]. 7. Be able to search the literature and present an oral presentation to class on a contemporary issue in bioreactions and bioreactors [7].
ASSESSMENT TOOLS	Links shown in brackets are to the course outcomes. 1. In class discussion and exercises with collaborative, group problem solving; in-class quiz [1-6]. 2. Graded homework assignments (biweekly) [1-6]. 3. Written examinations (one midterm exams and one final exam) [1-6]. 4. Oral presentations with powerpoint slides [1-7]. 5. End of term student evaluations [1-7]