Course Profile: Biomedical Engineering Program

COURSE #: BIOMEDE 418	**COURSE TITLE:** QUANTITATIVE CELL BIOLOGY
TERMS OFFERED: Winter	**PREREQUISITES:** Biochemistry and Intro Physics, Chem and Calculus
TEXTBOOK/REQUIRED MATERIAL: "Molecular Cell Biology" by Lodish et al.	**COGNIZANT FACULTY:** A. Hunt **DATE OF PREPARATION:** 12/12/00
INSTRUCTOR(S): A. Hunt	**SCIENCE/DESIGN:** 4/0
CATALOG DESCRIPTION: This course introduces the fundamentals of cell structure and functioning. The goal is to provide a general background in cell biology, with emphasis placed on physical aspects that are of particular interest to engineers.	**COURSE TOPICS:** Introduction to cell structure; bacterial flagella; introduction to Eukaryotic cells; intracellular organelles; electron transport in chloroplasts and mitochondria; ATP synthase; cytoskeleton; protein synthesis and processing; mitosis; cell cycle; signal transduction; extracellular matrix; cell adhesion systems; microfilament regulation and myosin.

COURSE OBJECTIVES*	1. Teach students fundamentals of cellular biology. 2. Show students how to formulate quantitative models of cellular processes. 3. Contrast descriptive and quantitative models of cellular processes. 4. Prepare students to understand advanced topics in molecular and cellular biology using quantitative tools. 5. Introduce students to systems approach in biology.

COURSE OUTCOMES*	1. Identify and describe the morphology, biochemistry and biological roles of major cellular structures. 2. Apply diffusion equations, chemistry, and biochemistry to model membranes in order to understand how they constrain and facilitate cellular functions such as electron transport, electrical activity, and regulation of intracellular chemistries. 3. Introduce Reynolds' number and consider how diffusion and the fact that momentum can be neglected constrain and facilitate cellular transport and morphologic changes. 4. Consider how processes such a signal transduction and cell division can be modeled quantitatively. This will include considering what new experimental data would have the greatest impact on the models' predictive values. 5. Consider the evolution of cellular structures. Apply evolution principals to understand mechanisms underlying cellular processes. 6. Provide an introduction to how the mechanical properties of cells can be determined by invasive manipulation by microneedles, viscous flow, or optical tweezers, or by non-invasive observation of thermal motion. 7. Apply statistical mechanics to model the energetics of mitochondria and electrically active cells. 8. Provide an introduction to how electrical properties of cells can be studied using voltage clam and patch clamp techniques. Introduce continuous cable model to describe the electrical properties of cells.
ASSESSMENT TOOLS	1. Homework assignments. 2. Exams. 3. Student discussion and questions. 4. Student evaluation of course.