Course Profile: Biomedical Engineering Program

COURSE #: BIOMEDE 331	**COURSE TITLE:** Introduction to Biofluid Mechanics
TERMS OFFERED: Fall	**PREREQUISITES:** Math 216 and BME 231, or permission of instructor
TEXTBOOK/REQUIRED MATERIAL: Munson et al. "Fundamentals of Fluid Mechanics" Course notes/ course pack	**COGNIZANT FACULTY:** J. Bull **DATE OF PREPARATION:** 8/25/2004
INSTRUCTOR(S): J. Bull	**SCIENCE/DESIGN:** 4/0
CATALOG DESCRIPTION: This course introduces the fundamentals of biofluid dynamics and continuum mechanics, and covers the application of these principles to a variety of biological flows. Fluid flow in physiology and biotechnology is invested at a variety of scales, ranging from subcellular to whole body.	**COURSE TOPICS:** 1. Fundamentals of fluid mechanics as they relate to living systems 2. Stress and strain 3. Conservation of mass, momentum and energy 4. Kinematics 5. Constitutive equations 6. Surface tension 7. Flow properties of blood 8. Bioviscoelastic fluids 9. Introductory dimensional analysis 10. Examples from the cardiovascular, respiratory, musculoskeletal, and nervous systems, as well as examples from biotechnology devices, will be examined.

COURSE OBJECTIVES*	Links shown in brackets are to the departmental educational objectives. 1. Introduce students to fluid mechanics as it relates to living systems. [1,14] 2. Teach students the fundamental concepts of fluid mechanics, including conservation of mass, momentum, and energy. [1] 3. Educate students to formulate and solve biofluid problems. [1,5] 4. Teach students the biofluid mechanics fundamentals of the cardiovascular, pulmonary systems. [1,13,14] 5. Introduce concepts relating to function and disease in physiology and medicine. [1,10,14] 6. Introduce students to fluid-structure interactions as they relate to pulmonary, cardiovascular, and cellular flows. [13] 7. Introduce students to the concept of non-dimensionaliztion. [1]

COURSE OUTCOMES*	Links shown in brackets are to the course objectives. 1. Relate stress and strain or rate of strain in a continuum. [1,2,4] 2. Determine the hydrostatic forces on planar and curved surfaces. [3] 3. Construct an appropriate control volume for a given flow situation and apply conservation of mass momentum, and energy. [2,3] 4. Develop ability to determine when the ideal fluid assumption is valid and apply the Bernoulli equation. [2,3,4,6]

	5. Interpret biological fluid data and select and apply appropriate constitutive equations, including Newtonian and non-Newtonian, to analyze flow in specific fluid systems. [1,3,4,6,7] 6. Apply the conservation laws in differential form, in velocity-pressure, steam function, and velocity potential formulations. [1,2,7] 7. Apply techniques of differential equations to solve biofluid mechanics problems. [3,7] 8. Determine dimensionless groups and relate these groups to physiological situations. [2,3,5,7] 9. Model flow in blood vessels ranging in size from capillaries to large arteries and veins, accounting for effects of cellular components of blood. [1-7] 10. Investigate interfacial tension effects in physiological flows. [1,2,3] 11. Solve problems at the interface of engineering and biology with respect to biofluid mechanics. [1-7] 12. Interpret data from living systems and address problems in biofluid mechanics. [1,2,3]
ASSESSMENT TOOLS	Links shown in brackets are to the course outcomes. 1. Homework assignments [1-7] 2. Exams [1-7]