Course alpha, number, title	ME 494 Biofluid Mechanics and Heat Transfer
Required or elective	Elective
Course (catalog) description	Applications of fluid mechanics, heat transfer, and thermodynamics to biological processes, including blood flow in the circulatory system, heart function, effects of heating and cooling on cells, tissues, and proteins. Pharmaco-kinetics.
Prerequisite(s)	(ME 410 or concurrently) or (CHE 311 or concurrently) or (BE 350 or concurrently)
Textbook(s) and/or other required material	Biomedical Engineering Principles, D.O. Cooney
Class/Lab schedule:	Total Credits: 3 *Lecture/Laboratory/Discussion Hours: 3/0/0*
Topics covered	Work done by the heart Blood rheology and flow in the cardiovascular system Transport across capillary and cellular membranes Engineering analysis of the kidneys Thermodynamics analysis of cryopreservation Modeling of bio-heat transfer: environmental and internal (i.e., the Pennes Bioheat equation) Response of proteins, cells, & tissue to heating & cooling Modeling of Burns and Thermal therapies Pharmacokinetics, the absorption & elimination of drugs by the body
Course learning objectives	On completion of the course, students should understand the contributions that an engineering approach provides in quantifying and explaining the fluid-thermal behavior of biological systems such as: the response of the heart to increased metabolism, pulsatile flow in the circulatory system (Windkessel and Wormersley models), transport due to osmotic pressure (with special emphasis on kidney function and cryopreservation), the response of proteins, cells, and tissues to heating and cooling, heat transfer in the body and between the body and the environment, and drug absorption and elimination in the body.
Relationship of course to ME program outcomes	The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes: 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis. (a) an ability to apply knowledge of mathematics, science, and engineering—3 (b) an ability to design and conduct experiments, as well as to analyze and interpret data—1 (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2 (d) an ability to function on multidisciplinary teams—2 (e) an ability to identify, formulate, and solve engineering problems—1 (f) an understanding of professional and ethical responsibility—2 (g) an ability to communicate effectively—2 (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1 (i) a recognition of the need for and the ability to engage in life-long learning—1 (j) a knowledge of contemporary issues—1 (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2 (l) application of advanced mathematics—1 (m) design, build, and test in mechanical systems area—1 (n) design, build, and test in thermal/fluids area—1 (o) capstone design experience—1
Contribution to	Engineering Science 100%.

professional component:	
Person(s) who prepared this description	Neil Wright
Date of Preparation	February 26, 2004 (revised 8 October 2009)