TO: The Engineering Faculty

FROM: The Faculty of the Department of Biomedical Engineering

RE: New Undergraduate-Level Course

The faculty of the Department of Biomedical Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

BME 306 Biotransport Laboratory

Sem. 2. Lab 3, cr. 1.

Prerequisite: ME 309 or equivalent
Corequisite: BME 304

Practical experience with fluid, mass, and heat transport principles and dimensional analysis relevant to biomedical applications. Experiments include simulations of normal and pathological conditions of blood flow with vessel constructs, mass transfer in unique boundary layers and molecular diffusion in cell and tissues, heat generation and transfer in biomaterials emphasizing tissue-tissue and tissue-cell interfaces.

Reason: Providing students with practical experience with the transport phenomena (mass, heat, and fluid) of physiological processes is important for reinforcing fundamental engineering principles within a biomedical context.

George Wodicka
Professor and Head

Supporting Documentation:

1. Level: Undergraduate – junior year

2. Course Instructor: Thomas J. Webster

3. Course Outline:

Fluid Transport (8 labs):
Lab 1: Low (capillary blood flow) and high (arterial blood flow) Reynolds number flow demonstration under normal and pathological conditions
Lab 2: Effect of wave propagation effects on fluid motion in the body (specifically, heart pumping frequency on blood, and eating/drinking frequency on food/fluid movement in digestive tract)
Lab 3: Use of dimensional analysis in laboratory (experimental) models for simulating *in vivo* capillary blood flow
Lab 4: Turbulent blood flow conditions on physiological and pathological responses of cells that line the vasculature (endothelial cells)
Lab 5: Development of arterioscelerosis due to flow separation at boundary layer flow in arteries.
Lab 6: Inviscid, incompressible blood flow around red blood cells in arteries, veins, and capillaries
Lab 7: Fluid mechanics of air flow in physiological and pathological conditions of the lung
Lab 8: Roughness effects on blood flow across vessel constructs

Mass Transport (4 labs):
Lab 9: Importance of mass transfer in unique boundary layers – biofilm and the foreign-body response layers
Lab 10: Mass transfer in the body independent of chemical reactions (lungs)
Lab 11: Mass transfer in the body dependent on chemical reactions (Na^+ and K^+ exchange)
Lab 12: Unsteady-state molecular diffusion such as in drug delivery mechanisms and effects on cell and tissues

Heat Transport (3 labs):
Lab 13: Heat generation and its effects through use of biomaterials (specifically, PMMA for bone prostheses, etc.)
Lab 14: Unsteady-state generation of heat during pathological conditions (such as fever conditions)
Lab 15: Heat transfer in arteriosclerosis (turbulent flow) conditions emphasizing tissue-tissue and tissue-cell interfaces
Week 16: *Finals week – no laboratory*

4. Text: laboratory manual to be prepared by the instructors and technical staff.

5. Grading: based on pre-laboratory assignments and weekly laboratory reports.