March 9, 2010

MEMORANDUM

TO: Darryll Pines  
Dean, A. James Clark School of Engineering

FROM: Elizabeth Beise  
Interim Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to Modify the Post-Baccalaureate Certificate in Engineering (PCC log no. 09041)

At its meeting on January 29, 2010, the Senate Committee on Programs, Curricula and Courses approved your proposal to modify the Post-Baccalaureate Certificate in Engineering by adding a specialization in Bioengineering. A copy of the approved proposal is attached.

The changes are effective Fall 2010. The School should ensure that the changes are fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

MDC/  
Enclosure

cc: Alex Chen, Chair, Senate PCC Committee  
Sarah Bauder, Office of Student Financial Aid  
Reka Montfort, University Senate  
Erin Howard, Data Administration  
Donna Williams, Institutional Research & Planning  
Anne Turkos, Archives  
Linda Yokoi, Office of the Registrar  
Thomas Castonguay, Graduate School  
Gary Pertmer, A. James Clark School of Engineering  
William Bentley, Bioengineering
Proposal for approving an academic option in Bioengineering to the existing Post-Baccalaureate Certificate in Engineering program through the Office of Advanced Engineering Education.

JUSTIFICATION/REASONS/RESOURCES (Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.)

See attached.

APPROVAL SIGNATURES - Please print name, sign, and date

1. Department Committee Chair
2. Department Chair
3. College/School PCC Chair
4. Dean
5. Dean of the Graduate School (if required)
6. Chair, Senate PCC
7. Chair of Senate
8. Vice President for Academic Affairs & Provost
Proposal for approving an academic option in Bioengineering to the existing Post-Baccalaureate Certificate in Engineering program through the Office of Advanced Engineering Education

Bioengineering (BIOE) will be a new academic option in the Post-Baccalaureate Certificate in Engineering (Z013) program which integrates the principles and applications embedded within engineering with the sciences of biology, medicine, and health. Like the students enrolled in the existing BIOE graduate program, they will gain the knowledge base and skill sets to quantitatively measure and rationally manipulate cells, tissues, and integrated systems. The curriculum as laid out below will consist of four core courses. Drawing upon the Clark School's strengths in Bioengineering, we will be able to offer working engineers and technical professionals access to the coursework and faculty at the forefront of biotechnology.

In addition to meeting departmental goals that are consonant with university and college goals — those related to interdisciplinary collaboration, nontraditional students, and outreach and scholarship—the academic option in BIOE will also meet more specific departmental goals. To this end, it will support the goal of integrating instructional, research and outreach efforts.

Need for the New Academic Option
Courses in this certificate will be valuable to practicing professionals who will need this education to keep pace with industry advances and acquire new skills. The certificate program will thereby help strengthen academic programs for non-traditional students. It seeks to prepare students for the challenges posed by the growing industrial base of the Washington, DC metropolitan area. There are a number of engineers, researchers, and medical professionals who have a desire to further their education in bioengineering and add more specialization to their background. Industries and institutions served by this certificate may include: the chemical and materials industries, healthcare, biotechnology, electronics and devices, and defense and security industries, as well as agencies including the Department of Defense, NIST, NIH, FDA, USDA, USPTO, and various intelligence agencies. The Post-Baccalaureate Certificate in Engineering represents an opportunity to acquire an essential specialization in bioengineering in a short program and on a part-time basis. The certificate program is designed to meet the education needs of both traditional and non-traditional students, allowing the completion of four specialized courses in Bioengineering.

Admission
Admission to the academic option in BIOE requires a Bachelor of Science degree in an engineering discipline from a recognized undergraduate institution. Admission may also be granted to students with a degree in another scientific discipline, such as biology, chemistry, physics, or mathematics. In some cases students may be required to take undergraduate courses to rectify deficiencies in their background before they are given permission to enroll in the required graduate courses. Specific undergraduate requirements are calculus-based physics, inorganic and organic chemistry, and mathematics through differential equations.

Curriculum
A minimum of 12 approved BIOE graduate credits is required to receive the certificate. Completion of any 4 of the following 8 courses is required and should be part of an integrated curriculum approved by the academic advisor.
BIOE 601 Rate Processes in Biological Systems
Presentation of techniques for characterizing and manipulating non-linear biochemical reaction networks. Advanced topics to include mathematical modeling of the dynamics of biological systems; separation techniques for heat sensitive biologically active materials; and rate processes in cellular and biomolecular systems. Methods are applied to current biotechnological systems, some include: recombinant bacteria; plant, insect and mammalian cells; and transformed cell lines.

BIOE 602 Cellular and Tissue Biomechanics
Introduction to the fundamentals of biomechanics including force analysis, mechanics of deformable bodies, stress and strain, multiaxial deformations, stress analysis, and viscoelasticity. Biomechanics of soft and hard tissues.

BIOE 603 Quantitative Cell Physiology
Introduction to the electrophysiology of the cell membrane. Development of mathematical models of different types of ionic membrane currents and fluid compartment models, culminating in the development of functional whole-cell models for neurons and muscle (cardiac, skeletal and smooth muscle) cells. Characterization of volume conductor boundary value problems encountered in electrophysiology consisting of the adequate description of the bioelectric current source and the volume conductor (surrounding tissue) medium.

BIOE 604 Transport Phenomena in Bioengineering Systems
A study of the transport processes of fluid flow, heat transfer, and mass transfer applied to biological organisms and systems, using analogical and systems approaches.

BIOE 612 Physiological Evaluation of Bioengineering Designs
Bioengineering-based designs of biomaterials, biomedical devices, imaging and drug delivery agents, tissue engineering, and prosthetics (among others), offer the opportunity to improve health care. This course is aimed at providing knowledge to lead bioengineering designs on the basis of biocompatibility and to provide tools to assess their patho-physiological impact in biological systems.

BIOE 620 Modern Methods of Drug Delivery
Basic concepts and physiochemical principles of drug delivery will be discussed. The course has three modules: orally and nasally inhaled drug products; Introduction of Statistical Thermodynamics and its Applications; Novel nanomedicine: Design considerations and applications.

BIOE 689C Biomedical Optics
Optical imaging, spectroscopy, and microscopy have become indispensable tools in modern biomedical research. This course will cover the principles and instrumentation of various biomedical optical techniques, including fluorescence and Raman spectroscopy, confocal and multi-photon microscopy, optical coherence tomography, and diffuse optical tomography. Biomedical applications will also be discussed.

BIOE 689Z Biosensor Techniques
This course provides a thorough review of fundamental concepts of biosensing systems, principles of common detection methods, and modern applications of biosensors. The course will be primarily literature driven. Students will obtain a detailed understanding of cutting-edge biosensing techniques, the instrumentation used, and the application space.
**Plan for Periodic Review of the BIOE Academic Option**

Changes in the course curriculum may precipitate the need to review the content and philosophy of the academic option in BIOE. There may be a need in the future to involve other departments more directly and may result in a slightly different program. This program is subject to review by the Bioengineering department’s advisory committee, which is comprised of faculty, as well as professionals serving a number of employers. The advisory committee and other professionals within the industry will be consulted regarding the scope and content of the BIOE academic option.

Like all of the academic options offered through OAEE, the BIOE academic options will be administered through OAEE, making sure that the necessary student services are provided. All content will be provided by the participating academic unit making sure that both commitment to support the programs and academic excellence are in place. Evaluation and assessment of the programs will be performed by both the participating academic units and OAEE, and their delivery through the Clark School of Engineering Distance Education Technology and Services office will ensure state-of-the-art accessibility of the associated courses.