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 Professional Master of Engineering (PCC log no. 09042)

At its meeting on January 29, 2010, the Senate Committee on Programs, Curricula and Courses approved your proposal to modify the Professional Masters of 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
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM PROPOSAL

DIRECTIONS:
- Provide one form with original approval signatures in lines 1 - 4 for each proposed action. Keep this form to one page in length.
- Early consultation with the Office of the Associate Provost for Academic Planning & Programs is strongly recommended if there are questions or concerns, particularly with new programs.
- Please submit the signed form to Claudia Rector, Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.
- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.

DATE SUBMITTED 11/11/09 PCC LOG NO. 09042

COLLEGE/SCHOOL ENGR

DEPARTMENT/PROGRAM OAEE

PROPOSED ACTION (A separate form for each) ADD X DELETE CHANGE

DESCRIPTION (Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide old and new sample programs for curriculum changes.)

Creation of an academic option in Bioengineering to the existing Professional Master of 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 William Boote I 11/12/09

3. College/School PCC Chair David B. Legg 11/4/09

4. Dean 2/11/09

5. Dean of the Graduate School (if required) 12/11/09

6. Chair, Senate PCC 11/11/09

7. Chair of Senate 11/11/09

8. Vice President for Academic Affairs & Provost 3/9/2010

VPAAP 8-05
Proposal for approving an academic option in Bioengineering to the existing Professional Master of Engineering program through the Office of Advanced Engineering Education

Bioengineering (BIOE) will be a new academic option in the Professional Master of Engineering (ENPM) 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 seven core courses and three elective courses. The student will select electives, whichever fits his/her needs, and will take courses with the approval of his/her academic advisor. 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 ENPM 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 academic option will be valuable to practicing professionals who will need this education to keep pace with industry advances and acquire new skills. The ENPM 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 program 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 ENPM academic option in BIOE represents an opportunity to acquire an essential specialization in bioengineering on a part-time basis. This academic option is designed to meet the education needs of both traditional and non-traditional students, allowing the completion of seven specialized core courses in Bioengineering.

Admission
Admission to the ENPM 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
The ENPM academic option in BIOE will require 30 credits of coursework. A minimum of 21 graduate credits from courses with a BIOE prefix is required as a "core". Three (3) of these credits may be an approved Independent Study (BIOE 689) project supervised by the student's advisor. Nine (9) credits are available to support program flexibility and are taken as electives. These could be selected from BIOE or other departments to provide a concentration in such topics as nanomedicine, biomedical devices, imaging, security, entrepreneurship, regulatory issues, and patent law, to name a few.

Core Courses (Completion of any seven of the following nine courses is required.)
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.

BIOE602 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

BIOE603 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.

BIOE604 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.

BIOE612 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.

BIOE620 Modern Methods of Drug Delivery
Basic concepts and physicochemical 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

BIOE689C 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.

**BIOE 611 Tissue Engineering**
A review of the fundamental principles involved in the design of engineered tissues and organs. Both biological and engineering fundamentals will be considered. A group project will emphasize the application of these fundamentals to the development of engineered tissues.

**BIOE 689 Special Topics in Bioengineering**
This is an independent study oriented course to be arranged between the student and a BIOE faculty member or BIOE affiliate faculty. Topics are self-selected and must include a written scholarly paper.

**Plan for Periodic Review of the ENPM Academic Option in BIOE**
Changes in the course curriculum may precipitate the need to review the content and philosophy of the ENPM 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 ENPM academic option in BIOE.

Like all of the academic options offered through OAEE, the BIOE 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.