January 4, 2017

MEMORANDUM

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

FROM: Elizabeth Beise  
        Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to Modify the Post-Baccalaureate Certificate of Engineering - Bioengineering Option (PCC Log No. 16022)

On December 15, 2016, the Senate Committee on Programs, Curricula and Courses approved the proposal to modify the Post-Baccalaureate Certificate of Engineering – Bioengineering Option. A copy of the proposal is attached.

The change is effective Spring 2017. Please ensure that the change is fully described in the Graduate Catalog and in all relevant descriptive materials.

MDC/  
Enclosure

cc: Andrew Harris, Chair, Senate PCC Committee  
    Barbara Gill, Office of Enrollment Management  
    Reka Montfort, University Senate  
    Chip Denman, Division of Information Technology  
    Pam Phillips, Institutional Research, Planning & Assessment  
    Anne Turkos, University Archives  
    Linda Yokoi, Office of the Registrar  
    Alex Chen, Graduate School  
    William Fourney, A. James Clark School of Engineering  
    George Syrmos, Office of Advanced Engineering Education
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM/UNIT PROPOSAL

College/School: ENGR
Please also add College/School Unit Code-First 8 digits: 01320101
Unit Codes can be found at: https://hypprod.umd.edu/Hnl_Reports/units.htm

Department/Program: Office of Advanced Engineering Education
Please also add Department/Program Unit Code-Last 7 digits: 1322302

Type of Action (choose one):
√ Curriculum change (including informal specializations)  New academic degree/award program
Curriculum change for an LEP Program  New Professional Studies award iteration
Renaming of program or formal Area of Concentration  New Minor
Addition/deletion of formal Area of Concentration  Other
Suspend/delete program

Summary of Proposed Action:
Changes to the curriculum of the existing Graduate Certificate in Engineering in Biomedical Engineering (Z054) program through the Office of Advanced Engineering Education.

Departmental/Unit Contact Person for Proposal: George Syrmos

APPROVAL SIGNATURES - Please print name, sign, and date. Use additional lines for multi-unit programs.

1. Department Committee Chair: Keith Herald
2. Department Chair: George Syrmos
3. College/School PCC Chair: Senna E. Bucci 4/28/16
4. Dean: Peter Kofinas/Designee
5. Dean of the Graduate School (if required): Lizzy Fernd 9/7/16 11/21/16
6. Chair, Senate PCC: Andrew 12/19/16
7. University Senate Chair (if required):
8. Senior Vice President and Provost: Elizabeth J. 11/4/17
Proposal for a Program Curriculum Modification for the existing Graduate Certificate in Engineering in Bioengineering (Z054) Program

1. Identification of and rationale for the changes.

Currently, the GCEN students and the BIOE Ph.D. students take the same Bioengineering courses, however their backgrounds and objectives differ greatly. As such, we would like to better align our courses and programs to ensure we are meeting the expectations and educational needs of both populations. Creating two separate groupings of courses for these populations will allow us to provide better learning outcomes for the GCEN students, as the new courses will be designed specifically to support their needs and will move away from the highly theoretical and mathematical foci of the Ph.D. courses. While maintaining some emphasis on theory, as it is relevant to the field, the GCEN focused courses will be more application oriented and highly relevant to industry applications. GCEN students will be able to apply the knowledge they are gaining through their courses directly into their careers in real time.

2. Current (old) requirements

- Graduate Certificate in Engineering in Bioengineering Current Requirements:
  - 12 credits/4 courses. No research/thesis.
  - Students choose 4 of the following courses:
    - BIOE601 Biomolecular and Cellular Rate Processes (3)
    - BIOE602 Cellular and Tissue Biomechanics (3)
    - BIOE604 Cellular and Physiological Transport Phenomena (3)
    - BIOE612 Physiological Evaluation of Bioengineering Designs (3)
    - BIOE631 Biosensor Techniques, Instrumentation, and Applications (3)
    - BIOE632 Biophotonic Imaging and Microscopy (3)

3. Proposed (new) requirements

- Graduate Certificate in Engineering in Bioengineering New Requirements:
  - 12 credits/4 courses. No research/thesis.
  - Students will take 1 course from the following core courses required for the BIOE M.Eng. degree
    - Modeling of biological systems
    - Application of Biomaterials
    - Biological transport phenomena
  - And students will take all 3 elective courses from the BIOE M.Eng. course offerings or the BIOE regular graduate offerings
    - Modeling of biological systems
    - Application of Biomaterials – BIOE 689D in Fall 2016
    - Biological transport phenomena
    - Synthetic biology
    - Bioinformatics
    - Tissue engineering
    - Biosensors
    - Imaging
    - Biostatistics
    - Biomedical device development
    - Biomechanics and mechanobiology
    - Physiology for Bioengineers
  - Other
4. **A sample program under the proposed requirements.**

GCEN students will take 1 core course and 3 elective courses from the BIOE M.Eng. course offerings. They can be taken in any order.

5. **List of new courses associated with the new requirements**

- All of these new courses are derivative from existing BIOE courses, reworked to support the needs of the GCEN students. BIOE will employ adjunct instructors/lecturers to teach these courses and will provide them with a suggested course plan.
- Courses can be taken in any order and have no prerequisite course requirements.
- All new course listed in the “Proposed (new) requirements” area, above, will be offered initially as BIOE689: Special Topics in Bioengineering (3 credits) and after the first offering will then be moved, through the VPAC process, to permanent numbers.

6. **List of courses being deleted from the current program requirements**

- All BIOE courses currently associated with the degree program are being deleted from explicit listing under the Graduate Certificate in Engineering in Bioengineering program requirements (note: these courses will still function as courses offered through BIOE for current M.S. and Ph.D. students and are not being deleted from the system completely). These courses will still be acceptable in the GCEN program as electives, with advisor approval.
  - BIOE601 Biomolecular and Cellular Rate Processes (3)
  - BIOE602 Cellular and Tissue Biomechanics (3)
  - BIOE604 Cellular and Physiological Transport Phenomena (3)
  - BIOE612 Physiological Evaluation of Bioengineering Designs (3)
  - BIOE631 Biosensor Techniques, Instrumentation, and Applications (3)
  - BIOE632 Biophotonic Imaging and Microscopy (3)

7. **Fulfillment of Required Curriculum**

- BIOE plans to roll out the 12 courses within the following time table:
  - Fall 2016 – 1 course
  - Spring 2017 – 2 courses
  - Fall 2017 – 3 courses
  - Spring 2018 – 3 courses
  - Fall 2018 – 3 course

- Students enrolling prior to the effective date of this curriculum change will be grandfathered and will have the option to complete the current course requirements (note: students are able to take any newly developed courses, as well, with advisor approval). Students enrolling after the curriculum change approval will be under the new requirements, but the advisor will exercise a high level of flexibility for students to take courses from the old requirements, if needed, to supplement the new courses until they are all fully developed.
Three Sample Course Plans for the Graduate Certificate in Bioengineering

The Graduate Certificate in Bioengineering is meant to support engineers in the BioTech industry with the need for focused technical skills. Included here are three sample course plans from a wide range of potential combinations. The Certificate is structured with considerable flexibility to meet the needs of a very diverse industry.

**Biomaterials and Biomedical Devices** – the related fields of Biomaterials and Biomedical Devices are keys to any company selling products with ultimate biomedical applications. This covers a wide range of large and small companies, all tied together by the harsh operating environment provided by the human body (or other living organisms). The list below provides a focus in this area:

- Application of Biomaterials
- Tissue Engineering
- Biomedical Device Development
- Physiology for Bioengineers

**Quantitative Bioengineering** – this course list is tied together by a focus on mathematics/analysis. This set is for engineers who enjoyed their math and physics courses. This one may be appropriate for engineers working in design who want a refresher with an emphasis on engineering analysis in bioengineering.

- Modeling of Biological Systems
- Biological Transport Phenomena
- Bioinformatics
- Biostatistics

**Biophysics** - this course list is tied together by a focus on biophysics. This set is for engineers who enjoyed their physics courses. This one may be appropriate for engineers working in design who want a refresher with an emphasis on the biophysics aspects of the field.

- Biological Transport Phenomena
- Physiology for Bioengineers
- Biomechanics and Mechanobiology
- Imaging
Hi Jenna,

Yes, I support the four proposals.

Thanks so much –

John

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John P. Fisher
Fischell Family Distinguished Professor & Department Chair
Fischell Department of Bioengineering
University of Maryland
2330D Jeong H. Kim Engineering Building
College Park, MD 20742
Phone: 301.314.2188
Email: jpfisher@umd.edu
Web: http://teblumd.net
Dear John,

If you support these four PCC proposals, would you please email be back stating we have your support? We understand Keith signed off; however Peter K. would like some type of verification we have your support as chair.

Thank you,
Jenna

-------- Forwarded message --------
From: Jenna Bucci <jdolan@umd.edu>
Date: Mon, Sep 19, 2016 at 3:55 PM
Subject: PCC Proposals
To: Peter Kofinas <kofinas@umd.edu>
Cc: George Symos <syrms@umd.edu>, "Keith E. Herold" <herold@umd.edu>, Jenna Bucci <jdolan@umd.edu>

Hi Peter,

Would you please review the following PCC proposals from OAEE / Bioengineering? These graduate programs require your signature (on the Dean’s signature line). They are straight forward and appear to have all of the required information.

If you do not have any questions/concerns please sign off (as the Dean) and email it back to me. I will then sign off as college PCC chair, and forward them to the Office of Academic Planning.

Jenna B.
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Bioengineering MEng/Graduate Certificate Program Learning Objectives

These bioengineering programs are designed to support working professionals who want to enhance their skills relating primarily to biotech industry jobs. As such, they focus on applications of bioscience and bioengineering knowledge. Learning objectives include:

1) a working knowledge of bioscientific/bioengineering theory

2) a working knowledge of mathematical tools, including the ability to apply mathematical tools to specific problems in bioscience/bioengineering

3) the ability to combine knowledge from a broad range of disciplines and to apply that knowledge to solutions of specific technical problems

4) the ability to implement research and development programs as part of a technical team

The following list of learning objectives for the bioengineering PhD and MS research programs is provided to shed light on the differences between the Professional programs and the research programs.

Bioengineering PhD/MS Program Learning Objectives

These programs are research programs. As such, they focus on bioscience and bioengineering fundamentals. Learning objectives include:

1) an in-depth understanding of bioscientific/bioengineering theory

2) the ability to understand mathematical concepts including the ability to apply mathematical methods to new bioscientific/bioengineering problems that may arise during research

3) the ability to combine knowledge from a broad range of disciplines and to synthesize that knowledge into new scientific/engineering theories

4) the ability to conceive and design research programs to better understand scientific observations

5) the ability to innovate bioengineering solutions to research problems

Outcomes Assessment

Master of Engineering and Graduate Certificate in Engineering Level

OAEE manages two graduate programs – the Professional Master of Engineering (ENPM) and the Graduate Certificate in Engineering (GCEN) and within each program are many academic options with separate program codes. At the graduate level, the University of Maryland, and in turn our programs, are held to the Middle States Accreditation standards. In order to continue maintaining that
accreditation, we have Graduate School-approved Assessment Methods, Criteria, and Results that we track and report in a graduate outcomes assessment on a regular basis. This data is reported to the Graduate School as a conglomeration of all academic option program codes within the ENPM and GCEN programs, respectively. Some of the program assessment criteria demonstrate more general outcomes surrounding overall knowledge of advanced principles in engineering based on things like retention in the program and cumulative GPA. However, other program assessment areas more specifically address learning outcomes in particular topic areas. For instance, each semester instructors of ENPM courses are asked to include a question on their final project or examination that requires each individual student to demonstrate an understanding of a fundamental principle in engineering relevant to each course topic area. The Office of Advanced Engineering Education then compiles and tracks this data by course. When reported to the Graduate School, and in turn Middle States, we provide one data point on the percentage of students able to demonstrate an understanding of a fundamental principle in engineering for the overall ENPM and GCEN programs, respectively. However, because this data is actually tracked and compiled on a semester basis by course, within our office we are also able to see trends in student learning outcome success in specific courses, as well as within blocks of courses associated with a particular academic option within one of our programs. (Assessment Methods, Criteria & Results sheets included in original proposal)

**MEng Course Re-Design**

The new courses we are designing for this program are primarily derived from existing courses. Thus, regular faculty have a direct role in the origin of those courses. From that origin, the courses are being and will be re-tooled to focus on the specific needs and learning objectives of the MEng student cohort. We have started the process this semester (Fall 2016) and it involved several meetings between the MEng program advisor and the adjunct faculty member to discuss the course design. These sessions were designed to communicate our vision of the program and to assess whether or not the instructor has an appropriate course philosophy for the MEng program. All new courses for this program will be reviewed by the Bioengineering Academic Affairs Committee following the same review procedure used for new courses in the Bioengineering MS and PhD programs.

The primary variable which will determine course and program quality is the “quality” and mind-set of the instructors. Thus, we will put a major effort into selecting instructors with a mind-set that blends academic rigor with the MEng program learning objectives. So far, the instructors have been chosen from our own PhD graduates who are working in local industry. These graduates are ideal for this program since they understand both the academic and industry perspectives. Since they were trained in our program, we feel confident that they understand and emulate a positive respect for academic rigor.

Going forward, we will implement reviews of all of the instructors in the form of unannounced classroom visits by the MEng program advisor. Observations from these visits will be combined with student surveys with the objective of maintaining and enhancing course quality.