December 8, 2009

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 Curriculum for the Ph.D. and M.S. in Bioengineering
(PCC log no. 09011)

At its meeting on December 4, 2009, the Senate Committee on Programs, Curricula and Courses approved your proposal to modify the curriculum for the Ph.D. and M.S. in Bioengineering. A copy of the approved proposal is attached.

The changes are effective Spring 2010. The College should ensure that the changes are fully described in the Undergraduate 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, Fischell Department of 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: November 18, 2009

Clark School of Engineering
Fischell Department of Bioengineering

PROPOSED ACTION (A separate form for each) ADD____ DELETE_____ CHANGE_X

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.)

We are modifying our PhD and MS programs to provide flexibility in course selection. The total credit hours remains the same (45 credits for PhD and 31 for MS). The requirements include 3 core courses, 2 restricted electives, and 3 unrestrictive electives. Paperwork is attached for both of these programs, detailing the changes being proposed.

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.)

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
We are modifying our PhD program to provide more flexibility in course selection. The most significant change is in regards to our core course requirements. Previously, we required four core courses, but have changed that requirement to three. We have also added a new core course to the required list. The two previous core courses that are no longer required are currently being proposed as electives. The current PhD program is listed at the end of this document. The total number of credit hours for the revised PhD program remains the same (45 credit hours). As noted, the revised curriculum includes: three core courses, two lab rotations, one seminar course, two restricted electives, and three unrestricted electives.

The Ph.D. program consists of:

1. 45 credits of required, restricted and unrestricted elective courses
2. a research aptitude examination (RAE)
3. an oral defense of a written dissertation research proposal
4. preparation and oral defense of a publication-quality dissertation that advances the field.

**Required Courses**

All students must take the following Bioengineering courses:

**Core Courses:**

BIOE 601 Rate Processes in Biological Systems

BIOE 604 Transport Phenomena in Bioengineering Systems

BIOE 612 Physiological Evaluation of Bioengineering Designs (new)

And:

BIOE 605/606 – Lab Rotation(s) (2 credits)

BIOE 608 - Bioengineering Seminar Series (1 credit)

*Attendance at all Bioengineering seminars is expected throughout the graduate student’s career, irrespective of whether the course is taken for credit or not.*

**Additional Requirements:**

A total of 18 credit hours of Dissertation Research credits must be taken (BIOE 899). Qualification for advancement to candidacy requires that students earn a GPA of 3.0 or better in each of the core courses. If a student receives a C in a core course, then it must be repeated.

Students must have completed 20 credits and have at least a 3.0 GPA at the end of the second semester to remain in good standing in the PhD program.
The Bioengineering Graduate Program has no explicit requirements regarding prerequisites; however, students are expected to have the Engineering Math and Biology background necessary to be successful at taking the core graduate courses. The Graduate Director may recommend that an incoming student take selected courses with significant Math and/or Biology content prior to attempting the Transport and Bioengineering Design courses.

**Elective Courses:**

In addition to the required courses, each student must take two restricted elective courses (6 credits). Restricted elective course consist of topics spanning fundamental bioengineering disciplines. The list of restricted electives will be updated every semester, reflecting current course offerings. The current restricted electives courses are shown below:

- BIOE602 Cellular and Tissue Biomechanics
- BIOE 603 Quantitative Cell Physiology
- BIOE 611 Tissue Engineering
- BIOE 620 Modern Methods of Drug Delivery
- BIOE 631 Biosensor Instrumentation and Techniques
- BIOE 653 Biomaterials
- BIOE 689C Biomedical Optics
- BIOE 689M Cell Engineering

Three more unrestricted electives courses (9 credits) will be selected in consultation with the student’s advisor. A list of approved electives can be obtained from the Bioengineering Graduate Program website.

**Summary of Revised PhD Course Requirements:**

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Required</td>
<td>9</td>
</tr>
<tr>
<td>2 Rotation</td>
<td>2</td>
</tr>
<tr>
<td>1 Seminar</td>
<td>1</td>
</tr>
<tr>
<td>2 Restricted Electives</td>
<td>6</td>
</tr>
<tr>
<td>3 Unrestricted Electives</td>
<td>9</td>
</tr>
<tr>
<td>Dissertation Research</td>
<td>18</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
Typical Timeline for completion of course requirements:

Fall Semester 1st Year: (10 credits)
- BIOE 601  (3 credits)
- BIOE 604 (3 credits)
- Restricted Elective (3 credits)
- Lab Rotation (1 credit)

Spring Semester 1st Year: (10 credits)
- BIOE 612  (3 credits)
- Restricted Elective (3 credits)
- Unrestricted Elective (3 credits)
- Lab Rotation (1 credit)

Fall Semester 2nd Year: (4 credits)
- BIOE 608 (1 credit)
- Unrestricted Elective (3 credits)

Spring Semester 2nd Year Courses: (3 credits)
- 1 Unrestricted Elective (3 credits)

Subsequent Semester(s):
- BIOE 898 or 899 Dissertation Research Credits (minimum of 18 BIOE 899 credits)
Current PhD program

Required Courses
All students must take the Bioengineering core courses: BIOE 601, 602, 603, 604 and the lab rotation courses 605/606. Attendance at the BIOE seminar series is also required (BIOE608). Additionally, a total of 18 credit hours of Dissertation Research credits must be taken (BIOE 899). Qualification for advancement to candidacy requires that students earn a GPA of 3.0 or better in each of the core courses.

Elective Courses
In addition to the required courses, each student must take two courses in the Life Sciences (only one of which can be at the 400-level; the other must be at the 600-level or higher) and two courses from Engineering, Mathematics or Computer Science offerings (only one of which can be at the 400-level; the other must be at the 600-level or higher). These electives will be selected in consultation with the student's advisor. A list of acceptable electives can be obtained from the BIOE website or the BIOE Graduate Program Coordinator.
We are in the process of modifying our PhD program to provide more flexibility in course selection. The PhD program provides the core format for our MS program, as well. We do not actively recruit MS students. Our MS is only offered to those PhD students who have not been able to meet all requirements for the PhD or have opted out of the PhD program and chosen to complete an MS. Because of the changes in the PhD program, we will also need to modify our MS program. The most significant change is in regards to our core course requirements. Previously, we required four core courses, but have changed that requirement to three. We have also added a new core course to the required list. The two previous core courses that are no longer required are currently being proposed as electives. The current MS program is listed at the end of this document. The total number of credit hours for the revised MS program remains the same (31 credit hours). As noted below, the revised curriculum includes: three core courses, one seminar course, two restricted electives, and three unrestricted electives.

The MS program consists of:

5. 31 credits of required, restricted and unrestricted elective courses
6. preparation and oral defense of a publication-quality thesis that advances the field.

**Required Courses**

All students must take the following four Bioengineering courses (*10 credits*)

BIOE 601 Rate Processes in Biological Systems

BIOE 604 Transport Phenomena in Bioengineering Systems

BIOE 612 Physiological Evaluation of Bioengineering Designs (new)

BIOE 608 Bioengineering Seminar Series (*1 credit*)

*Attendance at all Bioengineering seminars is expected throughout the graduate student’s career, irrespective of whether the course is taken for credit or not.*

**Additional Requirements:**

A total of 6 credit hours of Thesis Research credits must be taken (BIOE 799). Qualification for the MS requires that students earn an average GPA of 3.0 or better overall in the required courses.

Students must have completed 20 credits and have at least a 3.0 GPA at the end of the second semester to remain in good standing in the MS program.

The Bioengineering Graduate Program has no explicit requirements regarding prerequisites; however, students are expected to have the Engineering Math and Biology background necessary to be successful at taking the core graduate courses. The Graduate Director may recommend that...
an incoming student take selected courses with significant Math and/or Biology content prior to attempting the Transport and Bioengineering Design courses.
November 20, 2009

William E. Bentley, Ph.D.
Robert E. Fischell Distinguished Professor & Chair
Fischell Department of Bioengineering
Rm 2330D Jeong H. Kim Engineering Bldg. (#225)
University of Maryland, College Park
College Park, MD 20742

Dear Dr. Bentley,

I have read and understood the change in the requirements for the Ph.D. in Bioengineering and that these changes will affect the MS program as well. I do not feel that these changes will in any way affect the MD/Master in Bioengineering Program. In fact the changes being made will increase flexibility in the program.

Thanks you for informing me of these changes.

Sincerely,

[Signature]

Jordan E. Warnick, Ph.D.
Assistant Dean & Professor
Director, MD/Masters Programs