June 8, 2015

MEMORANDUM

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

FROM: Elizabeth Beise
       Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to Establish a Combined Bachelor’s/Master’s Program in Chemical Engineering (PCC log no. 14047)

At its meeting on May 1, 2015, the Senate Committee on Programs, Curricula, and Courses (PCC) approved your proposal to establish a combined Bachelor’s/Master’s Program in Chemical Engineering. A copy of the approved proposal is attached.

The change is effective Fall 2015. Please ensure that the change is fully described in the Graduate and Undergraduate Catalog and in all relevant descriptive materials, including the undergraduate program’s four-year plan (contact Lisa Kiely at lkiely@umd.edu for more information).

MDC/

Enclosure

cc: Gregory Miller, Chair, Senate PCC Committee
    Barbara Gill, Office of Student Financial Aid
    Reka Montfort, University Senate
    Erin Taylor, Division of Information Technology
    Pam Phillips, Institutional Research, Planning & Assessment
    Anne Turkos, University Archives
    Linda Yokoi, Office of the Registrar
    Cynthia Stevens, Undergraduate Studies
    Alex Chen, Graduate School
    William Fourney, A. James Clark School of Engineering
    Sheryl Ehrman, Department of Chemical and Biomolecular Engineering
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM/UNIT PROPOSAL

- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.
- Please submit the signed form to the Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.

College/School:
Please also add College/School Unit Code-First 8 digits: 01203200
Unit Codes can be found at: https://hvpprod.umd.edu/Html_Reports/units.htm

Department/Program:
Please also add Department/Program Unit Code-Last 7 digits: 3203200

Type of Action (choose one):

- Curriculum change (including informal specializations)
- Renaming of program or formal Area of Concentration
- Addition/deletion of formal Area of Concentration
- Suspend/delete program

Italics indicate that the proposed program action must be presented to the full University Senate for consideration.

Summary of Proposed Action:

Create a 5 year Bachelor's/Master's (with thesis) Program in the Department of Chemical and Biomolecular Engineering. This program will provide an integrated learning experience for excellent students in the Department. The program should help to attract top students to the undergraduate program and allow superior students in the ChBE undergraduate program to continue for a graduate degree.

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

1. Department Committee Chair
   R.A. Adams
   3/28/2014

2. Department Chair
   Sheryl H. Farkas
   10/29/2014

3. College/School PCC Chair
   William Bucci
   3/13/15

4. Dean
   P.A. 2015
   3/12/2015

5. Dean of the Graduate School (if required)

6. Chair, Senate PCC
   Gregory Miller
   6/1/15

Senior Vice President and Provost
Elizabeth J. Beineke 6/8/2015
5-year B.S./M.S. (with thesis) in ChBE:

Eligibility:
- Students should apply to the B.S./M.S. program at the end of their 6th semester in the B.S. program in ChBE at UMD.
- Transfer students should have completed the core ChBE courses in a typical 6th semester (i.e., ChBE 424 and 426).
- It is highly recommended (but not required) that the student should have already started research with one of the professors in the ChBE department (the “research advisor”) at the time of application.

Application Materials:
- Official Transcript
- Letters of Recommendation (3)
- Statement of Purpose (essay)

Note 1: GRE not required
Note 2: If the student has a research advisor, that professor should be one of the letter writers. If the student does not have a research advisor, he/she should approach a potential research advisor and obtain a letter from this person.

Evaluation:
- Applications will be evaluated by the ChBE Graduate Committee.
- Students should have a minimum GPA of 3.0 for admission. In addition, it is highly recommended that the student should have at least a B average in the ChBE core courses up to the 6th semester (ChBE 101, 250, 301, 302, 410, 422, 440, 424, 426).
- Letter of recommendation from research advisor (current or potential) will be a key factor in admission decisions.
- Decisions will be conveyed before the 7th semester (before senior year). Admitted students would declare that they are in the B.S./M.S. program at that time.
- At the time the student is accepted, he/she will be assigned to the research advisor who recommended the student. Course advising will also be done by this advisor.

Requirements of the M.S. degree:
- Total 30 credits. See sample programs.
- 3 elective courses = 9 credits will be double counted to B.S. and M.S. (All these courses will be at the 600 level.)
• 21 additional credits spread out over Years 4 and 5 (typically will involve just 4 additional courses, which will be the ChBE graduate core courses).

• At the end of Year 5 (10th semester) or during the subsequent summer, student should write and defend an M.S. thesis.

FAQ

• Why should students consider joining this program?
  – The combination of a B.S. degree in ChBE with a more advanced M.S. degree in ChBE could increase the prospects of employment and career growth for students, regardless of their future goals.
  – For students who are planning to join medical school, the research they conduct towards an M.S. thesis could provide invaluable experience, especially if they were planning to take a year off before starting medical school.
  – For students who are interested in graduate school but are unsure as to whether they should do a Ph.D., the 1-year M.S. could provide an avenue to take stock of their career options.

• What are the requirements of this program with regard to research?
  – The program is intended for students who are interested in conducting graduate-level research. Thus, it is imperative for students to complete and defend an M.S. thesis at the end of Year 5 (either at the end of the semester or in the summer).
  – If the thesis is not completed by the end of the summer after Year 5, the student can stay an extra semester (or two) and finish the thesis. However, it is not in the interest of the student to delay this process.
  – It is expected that the student would focus on research over at least one summer (preferably between Years 4 and 5).

• Can students withdraw from the program? If so, what degree(s) will they get?
  – Students can withdraw from the program before or during Year 5. If so, they will still receive the B.S. degree in ChBE.
  – To receive the M.S. degree in ChBE, they have to fulfil the requirements with respect to both coursework and research (i.e., complete a thesis).
  – We do not offer an M.S. degree based only on coursework. The M.Eng. degree in ChBE is administered by the Office of Advanced Engineering Education (OAEE). Note that this degree requires a full 30 credits of coursework over and above the B.S. (no double counting), and typically requires a full 2 years to complete.
• **Can a student stay on beyond M.S. and complete a Ph.D. in ChBE?**
  
  - Yes, a student can apply to the Ph.D. program in ChBE while they are in the B.S./M.S. program. Application guidelines for the Ph.D. program will apply in this case: specifically, the student will have to take the GRE general test. Application to the Ph.D. program is highly competitive. It should be noted that all Ph.D. students in ChBE are supported with a full stipend by their advisors.

• **Can a student in the B.S./M.S. program receive a stipend?**
  
  - Yes, students in the program can receive a stipend at the discretion of their advisor and subject to the availability of funds in the advisor’s lab. This will be the case especially in Year 5, when the student will be treated on par with regular M.S. students in ChBE (some of the current M.S. students receive a full or partial stipend from their advisors).

• **What are the relative benefits of Sample Program I or II for the B.S./M.S.?**
  
  - Ideally, the student’s research can be maximized if the coursework is reduced during a semester. Thus, Sample Program II allows the student to complete many of the required graduate courses by the end of Year 4, allowing the student to devote more of Year 5 to research. Sample Program I, on the other hand, balances coursework and research over the two years.
Current Program for B.S. Students in ChBE in their Final (4th) Year:

Year 4, Fall (7th sem): 15 credits total
- CHBE 437, Lab (3)
- CHBE 442, Process Control (3)
- CHBE 444, Design I (3)
- Elective 1 (3)
- Gen Ed (3)

Year 4, Spring (8th sem): 12 credits total
- CHBE 446, Design II (3)
- Elective 2 (3)
- Elective 3 (3)
- Gen Ed (3)

Sample Program I for Students in B.S./M.S. (5-Year) Program:

Year 4, Fall (7th sem): 15 credits total
- CHBE 437, Lab (3)
- CHBE 442, Process Control (3)
- CHBE 444, Design I (3)
- Elective 1 (3) (Double counted)
- Gen Ed (3)

Year 4, Spring (8th sem): 12 credits total
- CHBE 446, Design II (3)
- Elective 2 (3) (Double counted)
- ENCH 648 (3) (Double counted)
- Gen Ed (3)

Year 4, Summer: 1 credit total
- ENCH 648, Indep Study (1)

Year 5, Fall (9th sem): 10 credits total
- ENCH 610, Grad Thermo (3)
- ENCH 620, Grad Math (3)
- ENCH 799, MS Research (3)
- ENCH 609, Seminar (1)

Year 5, Spring (10th sem): 10 credits total
- ENCH 630, Grad Transport (3)
- ENCH 640, Grad Kinetics (3)
- ENCH 799, MS Research (3)
- ENCH 609, Seminar (1)
- M.S. Thesis Defense

Summary: 10 credits in Year 4, 20 credits in Year 5; Total = 30 credits for M.S.
Sample Program II for Students in B.S./M.S. (5-Year) Program:

Year 4, Fall (7th sem): 15 credits total
- CHBE 442, Process Control (3)
- CHBE 444, Design I (3)
- Elective 1 (3) (Double counted)
- ENCH 620, Grad Math (3)
- Gen Ed (3)

Year 4, Spring (8th sem): 15 credits total
- CHBE 446, Design II (3)
- Elective 2 (3) (Double counted)
- ENCH 630, Grad Transport (3)
- ENCH 648 (3) (Double counted)
- Gen Ed (3)

Year 4, Summer: 1 credit total
- ENCH 648, Indep Study (1)

Year 5, Fall (9th sem): 7 credits total
- ENCH 610, Grad Thermo (3)
- ENCH 799, MS Research (3)
- ENCH 609, Seminar (1)

Year 5, Spring (10th sem): 7 credits total
- ENCH 640, Grad Kinetics (3)
- ENCH 799, MS Research (3)
- ENCH 609, Seminar (1)
- M.S. Thesis Defense

Summary: 16 credits in Year 4, 14 credits in Year 5; Total = 30 credits for M.S.
Below is a list of ChBE electives taught over the last three years. In each case, the course has an undergraduate section and a graduate section. Students in the BS/MS program will have to register for the graduate section.

<table>
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<tr>
<th>Elective name</th>
<th>UG listing</th>
<th>GR listing</th>
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<tbody>
<tr>
<td>1. Photovoltaics: Solar energy</td>
<td>CHBE 451</td>
<td>ENCH 648L</td>
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<td>2. Electrochemical energy engineering</td>
<td>CHBE 473</td>
<td>ENCH 648K</td>
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<td>3. Molecular modeling methods</td>
<td>CHBE 476</td>
<td>ENCH 648P</td>
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<td>4. Mesoscopic and nanoscale thermodynamics</td>
<td>CHBE 477</td>
<td>ENCH 648Q</td>
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<tr>
<td>5. Bionanotechnology: Physical principles</td>
<td>CHBE 480</td>
<td>ENCH 648N</td>
</tr>
<tr>
<td>6. Biochemical engineering</td>
<td>CHBE 482</td>
<td>ENCH 648B</td>
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<tr>
<td>7. Metabolic pathway engineering</td>
<td>CHBE 484</td>
<td>ENCH 648M</td>
</tr>
<tr>
<td>8. Catalysis for energy applications</td>
<td>CHBE 486</td>
<td>ENCH 648E</td>
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<tr>
<td>9. Tissue engineering</td>
<td>CHBE 487</td>
<td>ENCH 648T</td>
</tr>
<tr>
<td>10. Polymer science</td>
<td>CHBE 490</td>
<td>ENCH 781</td>
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A full list of ChBE graduate-level electives can be found at the link below. Some of these courses have not been taught for several years. [http://www.chbe.umd.edu/graduate/courses](http://www.chbe.umd.edu/graduate/courses)
Master of Science (M.S.) in Chemical & Biomolecular Engineering

Requirements: http://www.chbe.umd.edu/graduate/msrequirements

- Total of 30 credits
- Coursework: 24 credits
- Research: 6 credits (ENCH 799)
- M.S. Thesis must be written and defended in front of a thesis committee

Coursework: 24 credits:
- 4 core graduate courses (ENCH 610, 620, 630, 640): 12 credits
- 2 semesters of graduate seminar (ENCH 609) (1 credit each): 2 credits
- 4 technical electives: 10 credits
M.S. Degree Requirements

A minimum of 30 credit hours of course work in technical areas relating directly to chemical engineering is required for the M.S. degree. Shortly after admission, the candidate, with the assistance of the Graduate Director, shall prepare a written plan of study which is consistent with the following additional requirements:

General Requirements

- GPA
- Time Limitations
- Transfer of Credit
- M.S. Thesis
- Selection of Advisor and Research Topic
- Typical Plans of Study

General Requirements

Before graduate courses in Chemical Engineering are attempted, the candidate must fulfill certain minimal course prerequisites either by previous experience or by taking selected undergraduate courses. These minimal prerequisites are described in the GPA and prerequisite policy page. Some of these prerequisites may be fulfilled by concurrent registration if necessary. No courses numbered below 400 may count towards the minimal 30 credits required for the degree. A maximum of 6 credits of 400 level courses may count towards the degree subject to prior approval by the Graduate Director. Graduate courses with an EMPM designation cannot be used to satisfy the minimum 30 hours without prior permission of the Graduate Director.

All graduate students (full and part-time, on and off campus) are expected to attend all research seminars, i.e., those not specifically directed to 1st year students. Students that fail to regularly attend research seminars will receive a notice from the director of graduate studies; extreme cases can be considered insufficient progress towards degree. Exceptions to this requirement will be made on a case-by-case basis by the graduate program committee; such exceptions include off-campus students that demonstrate regular participation in an on-campus seminar series that takes place at a more convenient time, or an off-campus technical seminar series. Students granted this exception should turn in a list of seminars attended to the director of graduate students before the end of each spring and fall semester.

The Department of Chemical and Biomolecular Engineering's overall expectations for all students enrolled in its graduate program are that they will:

- make significant scholarly contributions to the field of chemical and biomolecular engineering, which is primarily measured by publications in peer-reviewed journals; and
- demonstrate an ability to communicate research findings to an audience of their peers in the field of chemical and biomolecular engineering, which is primarily measured by presentations at conferences.

These publications and presentations must be documented on the final page(s) of each student's written thesis. For details, see "M.S. Thesis," below.
CPI

Graduate School requires students to maintain a 3.0 GPA in all courses for credit since enrollment. The Department of Chemical and Biomolecular Engineering further requires that students attain at least a 3.0 GPA in the four required graduate core courses–ENCH 610, 620, 630 and 640–where this GPA is computed using the letter+/- system. This GPA is computed by the following numerical equivalents:

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<th>A-</th>
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<th>C+</th>
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<td>2 2/3</td>
<td>2 1/3</td>
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Therefore, receiving the grades of B-, B, B-, and C- in the four core courses would not be sufficient to receive a graduate degree from the Department of Chemical and Biomolecular Engineering.

Time Limitations

All requirements for the M.S. degree must be completed within a five year period. This time limit applies to any transfer work from other institutions to be included in a student's program. Students who fail to complete all requirements for the degree following the granting of a time extension by the department may seek an additional extension by petitioning the department. If the department supports the request, the Administrator of Graduate Admissions and Records may grant up to a one year additional extension.

Transfer of Credit

A maximum of 6 semester hours of graduate course work taken at other regionally accredited institutions prior to matriculation in the Graduate School, or afterward, may be applied toward the Master's degree. The course must have been taken within the time limits for completing the Master's degree; the Graduate Director must agree that the specific courses are appropriate to and acceptable in Chemical Engineering, and the student is responsible for providing an official transcript of this work to the Graduate School.

Due to academic and procedural differences between U.S. regionally accredited and foreign institutions, credit from foreign universities is not normally acceptable for transfer.

The grades on transfer work do not affect the grade point average of the work taken at the University of Maryland. A grade of A from another institution cannot balance a C in a course here.

Transfer work cannot be used to satisfy the requirements for upper level courses in a student's program. The required credits of 600 level or above must be part of the work taken at the University of Maryland.

No credit transfer will be allowed for any courses which have been used in fulfillment of the requirements of any other degree. No credit will be granted for correspondence courses.

The request for transfer credit shall be submitted to the Graduate School for approval at the earliest possible time. The candidate is subject to final examination by this institution in all work offered for the M.S. degree.

M.S. Thesis

For the M.S. Thesis, 6 of the required credit hours are devoted to Research (ENCH 799). While the student may elect to take more than 6 credits of ENCH 799, only 6 credits may be used to fulfill the credit hour requirements. Upon completion of the research, the student prepares a dissertation on his/her research and must pass a final oral examination.

The proposal committee must include at least three (3) members of the regular faculty in ChBE. These faculty members are listed under the “Regular Faculty” tab of the faculty directory on this website.

An exemption from the above requirement can be granted under special cases. To request an exemption, the student’s advisor must petition the Graduate Director detailing specific reasons for the request and listing the modified committee. The Graduate Director will make a decision on the request after consulting with the Graduate Studies Committee.

The following must be documented on the final page(s) of each student’s written thesis:

1. A list of publications on which the student is either the first author or a co-author. Provide the full citation (title, all authors, DOI, etc.). Subdivide into:
   a. Publications that have appeared in print: specify full citation
   b. Publications that have been submitted and are under review: specify dates
c. Publications that will be submitted after the defense: specify tentative titles, and dates

2. A list of conference presentations on which the student is either the first author or a co-author. Provide full details (title, authors, etc.). Specify speaker. Subdivide into:
   a. Presentations that have been delivered
   b. Presentations that have been scheduled (abstract accepted): specify dates
   c. Presentations for which abstracts will be submitted: specify tentative titles, and dates

After successful completion of the defense, a copy of the above page(s) will be made and placed in each student's folder. The Graduate Director will not sign off on the student's defense form if the above requirements are not met.

**Selection of Advisor and Research Topic**

Please see the research advisor selection form.

**Typical Plans of Study**

In principle, a candidate fulfilling all of the General Course requirements can complete the requirements for the Master of Science degree in one year. However, it is unusual for students to complete their program in less than 3 semesters. For candidates having a previous degree in a non-Chemical Engineering technical area, a 2 to 2.5 year program is usually necessary. An example plan of study is given in the M.S. Course Requirement Advising Form (.docx). Individual plans of study will be developed upon request by the Departmental Graduate Director.