May 24, 2017

To: Sarah Mangelsdorf, Provost and Vice Chancellor for Academic Affairs

From: Ian Robertson, Dean of the College of Engineering

Re: Final Summary of Review for the Biomedical Engineering Graduate Program

The Biomedical Engineering Graduate Program review was completed by a review committee chaired by: Parmesh Ramanathan, Professor of Electrical and Computer Engineering, with members: Daniel Nogueria, Professor of Civil and Environmental Engineering; Brian Pfleger, Professor of Chemical and Biological Engineering; and Nicole Perna, Professor of Genetics.

The review committee was charged with assessing the strengths and weaknesses of the program and recommendations for future directions. The College of Engineering APC discussed and approved the review committee report on May 17, 2017. Based on my review of their report and the APC response, I am providing the following executive summary of the program review:

Overview

Strengths of the BME Program include excellent faculty who are highly involved with students and degree programs, PhD students who are very satisfied with the program, an excellent track record of recruiting minority students, and a degree program that is highly tailored to student interests, is highly interdisciplinary, and has a clear set of learning goals as well as an assessment plan.

Weaknesses of the BME Program include limited communication from the department regarding changes being planned for the graduate program, research facilities in different locations on campus that create communication challenges, a program that is highly dependent on real-time faculty advising and personalized examinations, and a lack of a formal program structure that introduces challenges for students navigating graduate courses and examinations.

Recommendations

Recommendations include creating a periodic newsletter to communicate with students and faculty, investigating the creation of graduate tracks to create program structure, revising the qualifying exams, ensuring that junior faculty have opportunities to teach specialized graduate level courses, and leading efforts to obtain NIH training grants that would provide rotational opportunities for PhD students.
Attachments
Review Committee Report

Copies
Justin Williams, Chair, Department of Biomedical Engineering
Paul Campagnola, Associate Chair of Graduate Advising, Department of Biomedical Engineering
Parmesh Ramanathan, Professor of Electrical and Computer Engineering, Chair, program review committee
Jocelyn Milner, APIR
Bill Karpus, Graduate School
Sarah Kuba, Associate Academic Planner, Academic Planning and Institutional Research
Marty Gustafson, Assistant Dean for Academic Planning and Assessment, Graduate School
Jake Blanchard, Executive Associate Dean, College of Engineering
Susan Hagness, Associate Dean for Research and Graduate Affairs, College of Engineering
Laura Albert, Assistant Dean for Graduate Affairs, College of Engineering
Review Committee Members

- Parmesh Ramanathan, Professor of Electrical and Computer Engineering (Chair)
- Brian Pfleger, Professor of Chemical and Biological Engineering
- Daniel Noguera, Professor of Civil and Environmental Engineering
- Nicole Perna, Professor of Genetics (Graduate Faculty Executive Committee Representative)

Review Process

1. The committee met on April 12, 2017 to review the program materials. At this meeting, the committee identified a set of questions to be asked during the visits to the department.

2. The committee members visited the BME program on April 13, 2017. There were three meetings on this day. The first meeting was with Professor Paul Campagnola (Associate Chair for Graduate Advising) and Pamela Peterson (Graduate Program Coordinator). The second meeting was with all the four Assistant Professors in the program (Assistant Professors Kris Saha, Randy Ashton, Meghan McClean, and Jeremy Rogers). The third meeting was with a group of 10 doctoral students; the students were in different stages of the program, ranging from first-year to sixth-year.

3. The committee members also visited the BME program on April 27, 2017. There were two meetings on this day. The first meeting was with five BME MS program students. The second meeting with Professor Justin Williams (chair of the BME department).

Overview of the Program

The Master of Science (MS) degree in Biomedical Engineering has been offered in this campus since the mid-1970s. The doctoral degree (PhD) in Biomedical Engineering was established in 1999. Both programs are administered through the Biomedical Engineering (BME) department in the College of Engineering.

The core faculty for the BME programs come from the BME department. The BME department has 19 tenure-track faculty and 67 affiliate faculty. Although the affiliate faculty may supervise graduate students in the program, most of the graduate students in the program have the BME tenure-track faculty members as their primary advisor. The BME department was established only 18 years ago; in fact, across UW-Madison was among the first few institutions to establish a BME department. BME PhD program’s national ranking has fluctuated between 20 and 24 in the past 7 years. The BME program is first among the public institutions in research expenditures per FTE and third among the public Universities in total research expenditures. The BME department recently completed a strategic planning process to identify their areas of excellence and the areas
in which they can increase their visibility, which in turn, they hope will result in improved USNWR ranking.

The BME PhD program matriculates about 10 students each year. Most of these students are direct admit into a faculty member’s laboratory. There is one NIH training grant led by a faculty member (Professor Justin Williams) in the BME department. Almost all BME faculty are trainers in NIH training grants at UW-Madison. The BME program takes advantage of some of these training grants to offer flexibility to incoming graduate students. However, the faculty feel that BME program loses out in recruiting many top students due to the lack of financial resources to offer flexibility/rotation to graduate students in the first year.

Most of the students in the BME MS program were undergraduates at UW-Madison. Many of them are BME undergraduates who opt to stay for an additional year to complete the MS program. Many of these students also receive financial support in the form of TAships, either in the lower level BME undergraduate courses or in courses such as Physiology (Phys 335).

The BME department recently got approval for a PhD minor in Quantitative Biology. The minor will only begin in Fall 2017. It was not part of this program review.

BME Program Strengths
1. Faculty are excellent and appear to be highly involved with students and degree programs
2. PhD students appear to be very satisfied with the program.
3. Highly visible publications in top journals indicate strong research program
4. Student post-degree placement is satisfactory
5. Degree is highly tailored to match student interests
6. Research program is highly interdisciplinary and provides students with exposure to multiple disciplines
7. Although the graduate students’ laboratories are in different buildings (Engineering Centers Building (ECB), Wisconsin Institute for Medical Research (WIMR), and Wisconsin Institute for Discovery (WID)), the Ph.D. students seemed to feel a sense of community. There is a graduate seminar which brings these students together on a regular basis. The graduate student association also does a good job of organizing social events to maintain a community among the doctoral students.
8. The program has a clear set of learning goals and an assessment plan for both programs.
9. The PhD program is successful in recruiting domestic minority students (24% of the domestic students are minority, with 16% targeted minority). The program also has a good gender balance (60% males, 40% females), especially in comparison to other engineering programs.
10. The MS program is also successful in recruiting domestic minority students 41% of the domestic students are minority, with 29% targeted minority). The program
also has a good gender balance (65% males, 35% females), especially in comparison to other engineering programs.

11. The committee met a few MS program students. These students felt that the MS program added considerable value to their undergraduate degree. Because of the MS program, these students felt that they were more marketable for industrial positions.

BME Program Concerns

1. Not much communication from department regarding changes being planned to graduate program, e.g., planned changes to qualifying exams. The communication is sparse both to Assistant Professors and to graduate students.
2. Program is highly dependent on real-time faculty advising and personalized examinations, which may be challenging as program grows and faculty turnover.
3. Most official TA positions are awarded to MS students who completed the same course as an undergraduate at UW-Madison. Teaching opportunities for interested PhD students are limited and reliant on their primary mentor’s teaching responsibilities.
4. The lack of formal program structure introduces challenges for new students to design and navigate their graduate course and examinations. This is particularly difficult for students of new faculty and further exaggerated by the distribution of labs across campus (see below).
5. Research facilities are in different locations on campus. Although not a weakness per se, it creates communication challenges.
6. The BME undergraduate program has a large number of students. The resulting large undergraduate teaching load, makes it difficult for faculty to offer specialized courses for graduate students.
7. The MS program students expressed dissatisfaction with Engineering Career Services (ECS). As per these students, many of the companies who recruit through ECS do not understand the value-add provided by the BME degree as compared to other engineering degrees such as Electrical Engineering, Computer Engineering, and Mechanical Engineering. As a result, the MS program students are not keen on using ECS services to find job opportunities. Instead, they rely on faculty advisors to help in identifying career opportunities. The students were optimistic about their career opportunities.

Recommendations

1. Have a periodic newsletter to communicate better with students and faculty. The newsletter can highlight faculty and student accomplishments, as well as draw attention to upcoming opportunities for professional development.
2. Investigate whether creating graduate tracks will help provide the missing structure.
3. Graduate students (at least the 10 who met with the committee) were satisfied with the structure of qualifying examinations. The program, on the other hand, is considering a revision of the qualifying examination procedure. The program
faculty should seek feedback from the graduate students regarding the qualifying examination as part of their process to revise the format.

4. Work with the College of Engineering to improve potential employers understanding of the scope and quality of BME student training. The scope and value-add provided by the BME training should be also be part of the messaging from Engineering Career Services to increase the career opportunities for BME students.

5. Consider alternate mechanisms to meet the different advising needs of PhD and MS students

6. Seek ways to ensure that junior faculty have the opportunity to offer specialized graduate level courses as part of their departmental teaching responsibility.

7. The limited resources for graduate fellowships is not likely to change dramatically in the next few years. To provide rotational opportunities to PhD students, the BME faculty may want to lead efforts to get one or two NIH training grants in the targeted areas of excellence.
Applicants, Admits and New Enrollments

<table>
<thead>
<tr>
<th>Period</th>
<th>Fall, 2006</th>
<th>Fall, 2007</th>
<th>Fall, 2008</th>
<th>Fall, 2009</th>
<th>Fall, 2010</th>
<th>Fall, 2011</th>
<th>Fall, 2012</th>
<th>Fall, 2013</th>
<th>Fall, 2014</th>
<th>Fall, 2015</th>
<th>Fall, 2016</th>
</tr>
</thead>
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<tr>
<td>New Enrollments</td>
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<td>14</td>
<td>22</td>
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<td>16</td>
<td>22</td>
<td>19</td>
<td>20</td>
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<tr>
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<td>13</td>
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<td>10</td>
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<td>20</td>
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<td>All</td>
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</tbody>
</table>

This visualization was created by the Graduate School. Questions should be directed to Peter Kinsley, peter.kinsley@wisc.edu.
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Students with an Appointment of 33% or Higher

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Distribution of Elapsed Years to Degree (Fall 2006 - Fall 2016)

<table>
<thead>
<tr>
<th>Degree Level</th>
<th>Less than 5 years</th>
<th>5-6 years</th>
<th>6-7 years</th>
<th>7-8 years</th>
<th>8-9 years</th>
<th>More than 10 years</th>
</tr>
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<tbody>
<tr>
<td>Doctorette</td>
<td>37.6%</td>
<td>35.8%</td>
<td></td>
<td>18.3%</td>
<td>3.7%</td>
<td>2.8%</td>
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</table>

Division

All

School / College

All

Academic Major

Biomedical Engineering, PHD

Gender

All

Diversity

All

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PhD Time-to-Degree Metrics, Peer Comparison

Select UW-Madison Program
Biomedical Engineering

Select Time-to-Degree Metric
Time at UW-Madison as a Gradu...

This visualization was created by Academic Planning and Institutional Research (APIR), Office of the Provost, UW-Madison. Questions should be directed to Sara Lazenby, sara.lazenby@wisc.edu.
Completion Rates by Fall 2016

Cohort Start Term
Fall, 2005

Division
All

School/College
All

Degree Level
All

Academic Major
Biomedical Engineering PHD

Gender
All

Diversity
All

- Completed: 55.6%
- Did not complete plan: 22.2%
- Left with a Master's: 22.2%

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PhD Retention/Completion Rates, Peer Comparison

Select a UW-Madison Program. Dashboard will populate the retention/completion rates for the UW-Madison program (top graph) and the retention/completion rates for comparable peer programs at other AAU institutions (bottom graph).

Select UW-Madison Program
Biomedical Engineering

UW-Madison Retention/Completion Rates (Biomedical Engineering)

<table>
<thead>
<tr>
<th>Number of years since PhD entrance cohort entered program</th>
<th>Percent of Entrance Cohort</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>85.7%</td>
</tr>
<tr>
<td>2</td>
<td>68.8%</td>
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<td>5</td>
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<td>9</td>
<td>56.3%</td>
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<tr>
<td>10</td>
<td>85.7%</td>
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</table>

Association of American Universities Peer Program Retention/Completion Rates (Biomedical Engineering)

<table>
<thead>
<tr>
<th>Number of years since PhD entrance cohort entered program</th>
<th>Percent of Entrance Cohort</th>
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<tbody>
<tr>
<td>1</td>
<td>93.7%</td>
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<tr>
<td>2</td>
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<td>3</td>
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<tr>
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<td>9</td>
<td>66.0%</td>
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<tr>
<td>10</td>
<td>74.7%</td>
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</tbody>
</table>

Student Status
- % Not Enrolled
- % Completed
- % Enrolled

This visualization was created by Academic Planning and Institutional Research (APIR), Office of the Provost, UW-Madison. Questions should be directed to Sara Lazenby, sara.lazenby@wisc.edu.
Degrees Awarded by Year

- **Division:** All
- **School/College:** All
- **Degree Level:** All
- **Academic Major:** Biomedical Engineering PhD
- **Named Option:** All

Select Demographics (All)

<table>
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<tr>
<th>Year</th>
<th>Count</th>
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<tbody>
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<tr>
<td>2008-2009</td>
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<td>2011-2012</td>
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<td>2014-2015</td>
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<tr>
<td>2015-2016</td>
<td>19</td>
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</tbody>
</table>

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Certificates and Doctoral Minors: Counts

Select Data Recency
Census date used for official cou...
Select Time Period
10 years

Credential Type
Doctoral Minor
Credential Name
Doctoral Minor in Biomedical En...

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