

# UNIVERSITY FACULTY SENATE FORMS

## Academic Program Approval

This form is a routing document for the approval of new and revised academic programs. Proposing department should complete this form. Detailed instructions for the proposal should be followed. A [checklist](#) is available to assist in the preparation of a proposal. For more information, call the Faculty Senate Office at 831-2921.

**Submitted by:** Dawn Elliott

phone number x1295

**Department:** Biomedical Engineering

email address dellott@udel.edu

**Date:** 2/23/2015

**Action:** Change status of Biomedical Engineering from PROGRAM to DEPARTMENT

(Example: add major/minor/concentration, delete major/minor/concentration, revise major/minor/concentration, academic unit name change, request for permanent status, policy change, etc.)

**Effective term**

15F

(use format 04F, 05W)

**Current degree**

BS, PhD

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

**Proposed change leads to the degree of:** no change

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

**Proposed name:** Department of Biomedical Engineering

Proposed new name for revised or new major / minor / concentration / academic unit  
(if applicable)

**Revising or Deleting:**

**Undergraduate major / Concentration:** N/A

(Example: Applied Music – Instrumental degree BMAS)

**Undergraduate minor:** N/A

(Example: African Studies, Business Administration, English, Leadership, etc.)

**Graduate Program Policy statement change:** N/A

(**Must attach** your Graduate Program Policy Statement)

**Graduate Program of Study:** N/A

(Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

**Graduate minor / concentration:** N/A

**Note: all graduate studies proposals must include an electronic copy of the Graduate Program Policy Document, either describing the new program or highlighting the changes made to the original policy document.**

**List new courses required for the new or revised curriculum. How do they support the overall program objectives of the major/minor/concentrations)?**

(Be aware that approval of the curriculum is dependent upon these courses successfully passing through

the **Course Challenge** list. If there are no new courses enter "None")  
N/A

**Supply support letter from the Library, Dean, and/or Department Chair if needed**  
(all new majors/minors will need a support letter from the appropriate administrator.)  
Letter from Dean attached

**Supply a resolution for all new majors/programs; name changes of colleges, departments, degrees; transfer of departments from one college to another; creation of new departments; requests for permanent status. See example of resolutions.**  
Attached

**Explain, when appropriate, how this new/revised curriculum supports the 10 goals of undergraduate education: <http://www.ugs.udel.edu/gened/>**  
N/A

**Identify other units affected by the proposed changes:**  
(This would include other departments/units whose courses are a required part of the proposed curriculum. Attach permission from the affected units. If no other unit is affected, enter "None")  
None

**Describe the rationale for the proposed program change(s):**  
(Explain your reasons for creating, revising, or deleting the curriculum or program.)  
See attached proposal

**Program Requirements:**  
(Show the new or revised curriculum as it should appear in the Course Catalog. If this is a revision, be sure to indicate the changes being made to the current curriculum and **include a side-by-side comparison** of the credit distribution before and after the proposed change.) See example of side by side.  
N/A

**ROUTING AND AUTHORIZATION:** (Please do not remove supporting documentation.)

Department Chairperson [Signature] Date 2/23/2015

Dean of College [Signature] Date 2/24/2015  
(By signing above, the Dean confirms that their college policies and bylaws have been followed correctly during consideration of the request described in this form.

The approval actions that were taken at the college level were (check all that apply) :

☒ college faculty vote ☐ college curriculum approval ☐ college senate approval

Chairperson, College Curriculum Committee [Signature] Date 2/25/2015

Chairperson, Senate Com. on UG or GR Studies \_\_\_\_\_ Date \_\_\_\_\_

Chairperson, Senate Coordinating Com. \_\_\_\_\_ Date \_\_\_\_\_

Secretary, Faculty Senate \_\_\_\_\_ Date \_\_\_\_\_

Date of Senate Resolution \_\_\_\_\_ Date to be Effective \_\_\_\_\_

Registrar \_\_\_\_\_ Program Code \_\_\_\_\_ Date \_\_\_\_\_

Vice Provost for Academic Affairs & International Programs \_\_\_\_\_ Date \_\_\_\_\_

Board of Trustee Notification \_\_\_\_\_ Date \_\_\_\_\_

**TO:** University of Delaware Faculty Senate

**FROM:** Babatunde Ogunnaike, Dean, College of Engineering



**DATE:** February 23, 2015

**RE:** Proposed creation of the Department of Biomedical Engineering

I am pleased to support the proposal to create the Department of Biomedical Engineering in the College of Engineering. The Biomedical Engineering Program, which began in 2010 as an undergraduate major with the goal of building it into a Department within a short time period, has enjoyed strong demand and remarkable success. It is restricted to 55 students per class and is in process to achieve permanent status this semester. At our UD recruiting events, we continue to see an increasing number of high school students, especially women—many of whom hold the strongest credentials in the prospective student population—showing great interest in biomedical engineering. In addition to a thriving undergraduate program, a graduate program initiated in 2012 now has 20 excellent students who are progressing toward doctoral degrees.

Biomedical Engineering is currently the primary home of seven full time faculty, to become 11 at full strength. We have recently hired top faculty candidates from institutions such as Cornell, Duke, Northwestern, Princeton, Rice, and the University of Pennsylvania. Moreover, as a testament to our interdisciplinary impact at UD, Biomedical Engineering has over 50 affiliated and secondary faculty from across the college, university, and regional health care institutions.

Virtually all nationally recognized engineering colleges have established departments of bioengineering or biomedical engineering. Given the ever-growing list of new initiatives in health sciences at the University of Delaware, a department of this type is critical to achieving the mandates of a 21<sup>st</sup> Century College of Engineering and for that matter, those of a modern research university. It is my opinion that creating a Department of Biomedical Engineering will be an important factor in our College's national recognition. In fact, I believe that the absence of a biomedical engineering department will affect our ability to recruit the best engineering students and to recruit and retain the best faculty; it will also have negative repercussions for biological and health science activities across campus.

The change in status from a Program to a Department will not require additional resources. Indeed the Biomedical Engineering Program has been functioning in the form of a department for several years. The Program Director's terms of appointment and responsibilities are the same as those for department chairs; the Director conducts annual faculty and staff appraisals and is subject to annual reviews by me in precisely the same manner as other department chairs. In addition to the undergraduate and graduate degree programs noted above, program bylaws and promotion and tenure documents are already in place. Moreover, as with every department in our College, this program has a separate budget and is subject to all the administrative policies that apply to departments.

The faculty of the college discussed changing the status of biomedical engineering to a department at the regular college faculty meeting in the fall of 2014. Subsequently, we had a vote and the status change was strongly approved by the faculty via mail ballot on November 13, 2014 (For: 77, Against: 0,

Abstain: 3, Non-votes: 50). As dean, I am convinced that the new department of Biomedical Engineering possesses all the attributes necessary to make it a great success and to become another spire of excellence in the College. The original plans for its creation were well conceived and, to date, have been executed excellently. Consequently, I am delighted to give this proposal my strongest possible recommendation for approval by the faculty senate.

# Proposal to Change the Status of Biomedical Engineering from a Program to a Department in the College of Engineering

## I. Goal and Rationale

The Biomedical Engineering (BME) Program is seeking to achieve the status of Department in the College of Engineering. The BME Program is currently functioning as a Department in the College in every way. Departmental features of the BME Program include Undergraduate and Graduate academic programs, tenured and tenure-track faculty, staff, an operating budget, offices, undergraduate teaching laboratories, research laboratories, bylaws and promotion and tenure documents.

From the onset of forming the BME Program, the intent was to move toward Departmental status when departmental functions were put into place, the college faculty were supportive, and the permanent status of the undergraduate academic program was progressing. These criteria have now been fulfilled.

The original intention of forming a BME Department was specified by (then) provost Tom Apple in the May 12, 2011 offer letter for the BME program director (bold/italics added):

“The Biomedical Engineering Program began officially during the 2010/11 academic year with the first class of freshmen. As the inaugural program director, we are looking for you to start a competitive graduate program immediately (recruit students and start small class AY 2012/13, first full class AY 2013/14), which in conjunction with the undergraduate program ***will ultimately develop into a department in accordance with the faculty senate guidelines.*** Under your leadership, we expect this department to develop a measure of stature that will place it near the top ranking in the field.

....

Let me reiterate that ***we are committed to working with you to build this program up to departmental status in a short time span.*** That change will require working through the College and the Faculty Senate, and ultimately, requires approval by the Board of Trustees.”

It is important to transition to Departmental status for several reasons:

- The BME Program is fully functioning as a Department in all senses except name.
- Continued success in recruiting undergraduate and graduate students will be helped by being a Department, as the vast majority of competing BME programs are Departments.
- Recruitment and retention of outstanding faculty will require Department status, as the intent and timeline toward forming a department is a frequent question from faculty applicants and the current UD BME faculty.
- External reporting of metrics as a Department, rather than as a Program within the Engineering College, is required to obtain appropriate national comparisons and rankings.
- To be competitive on the national landscape, and considered a world-class biomedical engineering entity, UD must be on equal footing with our peer and aspirant Departments.

## II. Approvals

Biomedical Engineering departmental status was unanimously approved by the BME voting faculty (For: 12, Against: 0).

The proposal for departmental status of biomedical engineering was presented and discussed at the College of Engineering 2014 Fall Faculty meeting. On November 10, 2014 Dean Tunde Ogunnaike distributed the slides presented at the faculty meeting and an email ballot to the voting faculty of the College, with a close date of November 13, 2014. The resolution to approve formation of a Biomedical Engineering Department passed by a majority vote of College of Engineering Faculty:

For: 77

Against: 0

Abstain: 3

Non votes: 50

## III. History of UD Biomedical Engineering

The biomedical engineering concentration was first introduced in 2002 by the Mechanical Engineering Department. Because of growing interest, the biomedical engineering concentration became a minor and was opened to other majors across the campus in 2007. With the further increasing demand, the Biomedical Engineering (BME) Program was created by a BME Task Force Committee consisting of faculty from five departments in the College of Engineering (Chemical, Civil, Electrical, Materials Science, and Mechanical Engineering). During the two planning years of 2008-2009, the committee spent the first year evaluating the need for such a program and exploring if the University of Delaware had the resources to establish an undergraduate degree program in biomedical engineering. Demand for a program in biomedical engineering at the University of Delaware was evident through (a) increased enrollment in the biomedical engineering minor (maintained through Mechanical Engineering), (b) longstanding expertise of biomechanics, biomaterials and biochemical engineering faculty, which carried over to content in courses offered, (c) requests from parents of prospective students at recruitment events, and (d) a survey conducted in EGGG 101 Introduction to Engineering (required of all engineering freshmen). The second year was spent planning the curriculum by examining the curricula at the top ten ranked biomedical engineering programs according to *US News & World Report*.

In December 2009 the Engineering faculty voted to approve the creation of a bachelor's degree in biomedical engineering and the Academic Program Approval Form and proposal were submitted to the faculty senate. The faculty senate provisionally approved the new Bachelors in Biomedical Engineering (BBE) in January 2010.

The BME Program at the University of Delaware was officially launched in Fall 2010. During new student orientation, 19 students declared BME as a major. The enrollment grew to full capacity (50) during the first year through the change of major process. BME has maintained its



status as a restricted major with capacity now set at 55 students per class. There are currently 220 BME undergraduate majors on campus.

In Fall of 2011 UD recruited professor Dawn Elliott from the University of Pennsylvania as the BME Program Director.

In Spring of 2012 the Faculty Senate approved provisional status for the new doctoral program in Biomedical Engineering. This graduate program is rapidly growing and is very strong. Currently in its third year, there are 18 full-time and 2 part-time BME doctoral students who are all progressing as expected toward their degrees.

The Biomedical Engineering Program is in the process of accreditation by the Accreditation Board for Engineering and Technology (ABET). The current cycle, immediately after the first graduating class in May 2014, was the first time UD BME was eligible for ABET review. In June 2014 UD submitted the ABET self-study. In October 2014 the university hosted the ABET evaluation team. Notably the ABET evaluators' highlighted two strengths of the Program: the Problem Based Learning courses in the ISE Lab and the extensive engagement by our students in undergraduate research. Following standard procedures, the on-site evaluation is being reviewed by the ABET commission, with a final decision to be made by August 31, 2015.

#### **Current Status - 2014**

The Permanent Status Program Review of the undergraduate major is currently in process with the Faculty Senate. This proposal to change the status of biomedical engineering from a Program to a Department is intended to follow the Permanent Status review through the Faculty Senate and Trustee approval processes.

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#### **Timeline of Biomedical Engineering Development**

<b>Date</b>	<b>Milestone</b>
2008–2009	<ul style="list-style-type: none"><li>• BME Task Force committee meetings</li><li>• College of Engineering vote in favor of Biomedical Engineering Program</li><li>• Proposal submitted to faculty senate</li></ul>
January 2010	<ul style="list-style-type: none"><li>• Proposal approved by faculty senate</li></ul>
Spring 2010	<ul style="list-style-type: none"><li>• University of Delaware Board of Trustees provisionally approves BME undergraduate program</li></ul>
Fall 2010	<ul style="list-style-type: none"><li>• BME undergraduate program begins with 18 students enrolled. Increases to 50 students by end of year.</li></ul>
Fall 2011	<ul style="list-style-type: none"><li>• 104 students enrolled – BME Program at full capacity</li><li>• Dawn Elliott hired as Program Director.</li></ul>
Spring 2012	<ul style="list-style-type: none"><li>• BME Graduate Program approved by Faculty Senate</li></ul>
Fall 2012	<ul style="list-style-type: none"><li>• 151 undergraduate students enrolled – BME Program remains at full capacity.</li><li>• 7 doctoral graduate students enrolled</li><li>• BME seminar series begins</li></ul>

	<ul style="list-style-type: none"> <li>• First External Advisory Council meeting</li> </ul>
Spring 2013	<ul style="list-style-type: none"> <li>• Capacity increases to 55 students per class</li> </ul>
Fall 2013	<ul style="list-style-type: none"> <li>• 206 undergraduate students enrolled – BME Program remains at full capacity</li> <li>• 15 doctoral graduate students enrolled.</li> <li>• Three new full-time Tenure-Track Assistant Professors hired: Christopher Price, Emily Day, John Slater</li> <li>• Annual External Advisory Council meeting</li> </ul>
Spring 2014	<ul style="list-style-type: none"> <li>• First 44 bachelor degrees in BME (39 graduates in May 2014 plus 5 from Jan 2014)</li> </ul>
Summer 2014	<ul style="list-style-type: none"> <li>• ABET accreditation self-study submitted</li> </ul>
Fall 2014	<ul style="list-style-type: none"> <li>• 210 undergraduate students enrolled – BME Program remains at full capacity</li> <li>• 20 doctoral graduate students enrolled.</li> <li>• ABET accreditation three-day evaluation visit</li> <li>• One new tenure-track Assistant Professor hired: Jason Gleghorn.</li> <li>• One new Assistant Professor of Instruction hired: Jeannie Stephens.</li> <li>• Permanent Status Program Review for BME Undergraduate Major submitted to Faculty Senate</li> <li>• College of Engineering vote in favor of Biomedical Engineering Department</li> </ul>

## IV. Description of the Biomedical Engineering Program

### 1) Faculty

The Biomedical Engineering Program currently consists of 7 primary faculty with appointments in Biomedical Engineering. These include 1 tenured full professor, 1 tenured associate professor, 4 tenure-track assistant professors, and 1 assistant professor of instruction. In addition there are 5 joint faculty with documented workload between 5-25% BME who contribute to the Program in terms of research, teaching, and service. These faculty include 2 tenured full professors, 2 tenured associate professors, and 1 tenure-track assistant professor. Importantly there are over 50 additional faculty who have secondary or affiliated faculty appointments and participate in the Biomedical Engineering Program through research, teaching, and service, including advising undergraduate and doctoral students. Please see website for full list of these affiliated faculty ([www.bme.udel.edu](http://www.bme.udel.edu))

### 2) Staff

The Biomedical Engineering Program staffing is consistent with all of the other College of Engineering Departments. BME staff includes a Business Administrator, an Academic Advisor, a Laboratory Manager, and an Administrative Assistant. In addition the College Business Office supports Biomedical Engineering in the same capacity as it supports the other Engineering Departments, including purchasing, grants management, and human resources.



### 3) Undergraduate Academic Program

#### Undergraduate Degree Information

The Bachelor of Biomedical Engineering degree program requires 126 credit hours. The first two years establishes a fundamental background in mathematics, biology, chemistry and physics, along with some introductory engineering. With this solid foundation, in the third and fourth year the students take technical engineering content relevant to biomedical applications. In the third year, students take materials science and engineering, bioengineering mechanics (including fundamentals of statics, dynamics and solid mechanics), quantitative cell and systems physiology, biomedical instrumentation, biotransport, and mathematical and experimental modeling. During the fourth year, students participate in the capstone senior design experience, a six-credit course that is jointly offered with the senior design program in mechanical engineering to form interdisciplinary teams. Courses in tissue engineering and medical imaging are also required in senior year. Technical electives are taken during the third and fourth years to provide the students with an opportunity to pursue areas of particular interest. In addition, the students are encouraged to work directly with faculty through research and independent study.

The biomedical engineering courses (BMEG prefix) are taught by the 12 primary and joint faculty. Other technical electives are taught by both BME faculty (BMEG prefix) and other UD faculty (for non-BMEG courses).

#### Undergraduate Student Information

Application and enrollment history and student quality based on SAT and high school GPA have been exceptionally strong, as shown in the Table below. Note that not all BME students enter the Program through the admissions process: some transfer in from other majors. This is particularly true for the first matriculation year in 2010, where only 19 joined BME through admissions and the class size grew to 50 during that academic year through the change of major process (a total of 44 BBE degrees were awarded from that cohort to date). Note also that upon opening of seats, students who wish to change major into BME immediately fill the seats, sustaining the Program at full capacity.

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**TABLE: Profile of BME Students by Year of Admission**

Academic Year	Sum of Applied	Sum of Admitted	Sum of Matriculated	AVG (NEW) Math/Verbal/ Writing	High School Percentile Rank	High School GPA
2010-11	19	19	19	1932	87	3.98
2011-12	429	193	49	1947	91	3.93
2012-13	600	174	48	1965	91	3.94
2013-14	653	214	50	1985	89	3.91

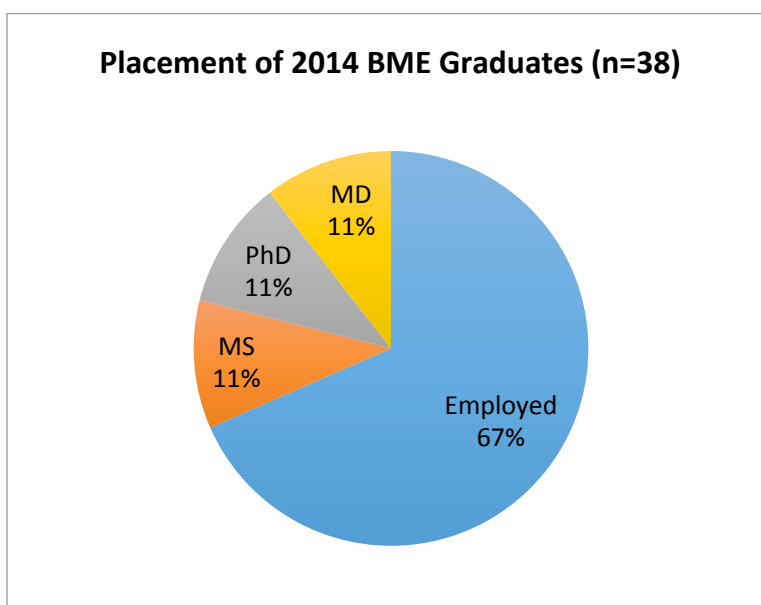
2014-15	763	224	46	2032	93	3.91
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Applied: indicated BME on application at any stage. Admitted: offered admission to BME.  
 Matriculated: enrolled in program. High school percentile rank is only available for roughly half of students reported. GPAs outside of standard range have been excluded from average GPA calculation (3 in 2010; 2 in 2011). Data Source: Admissions Data Mart, University of Delaware Enterprise Warehouse.

## Placement of Graduates

The first 44 bachelor's degrees in Biomedical Engineering were awarded in 2014, with 5 graduates in January and 39 in May. While there is no official source of post-graduation placement, we have collected information directly from the students via email or have identified their placement via their LinkedIn or Facebook pages. Of the 44 graduates, we know the placement for 38 (86%). Of these 38 graduates, 67% are employed, 11% each are in masters degree programs, doctoral degree programs, and medical school (Figure).

Some of the employers of our graduates include: Agilent, Ahnolt Industries, Bank of America, BrainLab, Danico Medical, EPIC, Food and Drug Administration (FDA), Goldman Sachs, Hamilton Robotics, the Hospital for Special Surgery, Johns Hopkins, Millstone Medical Outsources, Seiberlich Trane, Terumo, Trenton Hospital, and Zimmer.



Representative job titles include: consultant, consumer product strategy analyst, lead engineering reviewer, operations analyst, product development engineer, product engineer, quality engineer, research engineer, sales engineer, and technical service analyst.

Of the graduates continuing their education, the master's degree students are pursuing degrees in engineering at Columbia University (BME), University of Delaware (ME), Drexel University (BME), and San Diego State (BME). The doctoral degree students are pursuing degrees at Colorado State (BME), University of Delaware (Physical Therapy), University of Florida (Rehabilitation Science), and University of Michigan (Pharmaceutical Science). The graduates pursuing medical degrees are attending Jefferson Medical College, Philadelphia College of Osteopathic Medicine, and State University of New York Upstate.

#### 4) Graduate Academic Program

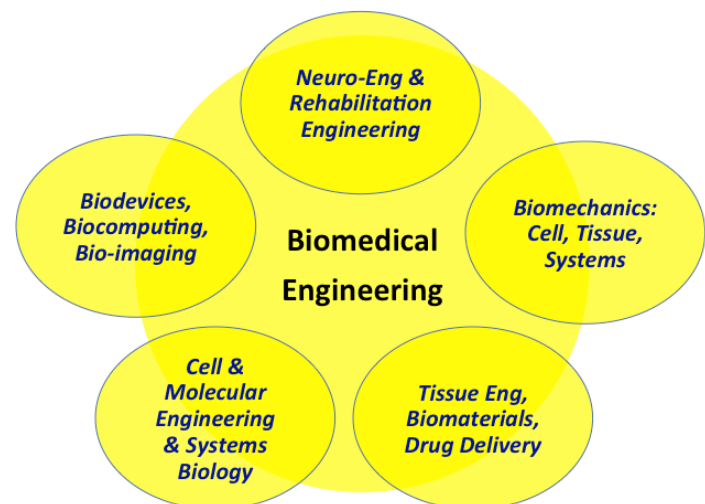
The Faculty Senate provisionally approved the BME graduate program in Spring 2012. Now in its third year, it has 18 full time and 2 part time doctoral students. Thus, on average, 6 PhD students matriculated each year. All 2012 and 2013 matriculates have passed their qualifying exams and are moving toward or have established PhD candidacy. The 2014 matriculates will take their qualifying exam during the summer of 2015.

The incoming doctoral students are academically strong, with an average undergraduate GPA of 3.3, GRE Verbal 75%ile, GRE Quantitative 81%ile, and GRE Analytical 56%ile. Diversity is good, with 33% women (6 of 18) and 22% under represented minorities (4 of 18). The majority of full time doctoral students are US citizens or permanent residents (83%, 15 of 18). In summary, the BME graduate program is thriving and well on its way toward applying for permanent status on schedule in 2018.

#### V. Research Focus

The topics in the undergraduate educational program and the research foci among the over 50 affiliated faculty are diverse and cover all aspects of biomedical engineering (Figure). Within this larger engineering landscape, the BME primary faculty have expertise and future growth plans to focus on the following three critical applications:

Musculoskeletal & Neural Engineering, Engineering Cancer Diagnosis & Therapy, and Regenerative Engineering. These are areas in which UD BME will establish a national reputation for excellence and will have tremendous impact on human health and well-being.



**Musculoskeletal and Neural Engineering.** This area includes clinical biomechanics, aging, injury, degeneration, repair, and regeneration of orthopedic and neural tissues and systems. Specific disorders and diseases include, among others, osteoarthritis, osteoporosis, lower back pain, sports injury, stroke, and spinal cord injury. Enabling core technologies include optical imaging and MRI. Key UD collaborators are in Physical Therapy, Biological Sciences, Materials Science and Engineering, and Mechanical Engineering. Clinical collaborators are at UD Physical Therapy, Nemours, Thomas Jefferson University, and the University of Pennsylvania.

**Engineering Cancer Diagnostics and Therapy.** This area includes diagnosis and treatment of multiple cancers, including breast cancer, bone cancer, and brain cancer. Enabling technologies include biomaterials, nanotechnology, imaging, and systems biology. Key UD collaborators are in Biological Sciences, Chemistry and Biochemistry, Materials Science and Engineering, Chemical and Biomolecular Engineering, and Electrical and Computer Engineering. Clinical collaborators are at Christiana Helen F. Graham Cancer Center and Nemours.

**Regenerative Engineering.** This area includes harnessing developmental biology, systems biology, biomaterials, and mechanobiology to develop organs and systems to treat human diseases. Key UD collaborators are in Materials Science and Engineering, Chemical and Biomolecular Engineering, Mechanical Engineering, Biological Sciences, and Chemistry and Biochemistry. Clinical collaborators are at Nemours, Thomas Jefferson University, and Christiana.

## VI. Financial and Space Resources.

### Budgetary Requirements

The BME Program is currently working within an operating budget model that is consistent with the other Engineering Departments. There are no additional budgetary requirements to convert BME from a Program to a Department.

### Offices

The BME Program occupies a total of 1589 sq. ft. of office space in two suites located in 161 Colburn and 301 Spencer Labs. The Colburn suite houses offices for the program director, business administrator, and administrative assistant. The Spencer Lab suite houses offices for the academic advisor and the instructional faculty, and a small meeting room. Offices for tenured and tenure-track faculty are located near their research laboratories at the Delaware Technology Park. BME graduate students, who work with faculty throughout the College of Engineering, occupy offices in the location of their research advisors.

### Teaching Laboratories

The Biomedical Engineering Program has some primary teaching laboratories and shares some teaching laboratories with the Mechanical Engineering and Electrical Engineering Departments. Each Department takes responsibility for various rooms, but all Departments share laboratories for efficient use of educational laboratory equipment and space. The following laboratories are in place for undergraduate teaching.

**TABLE 1: Summary of space utilized for BME undergraduate education (excluding classrooms and computer labs)**

Room Location	Room Size (sq. ft.)	Biomedical Engineering Course	Department in Charge
ISE Rm 322	1,024	BMEG 450 team collaborative space; seminars; classes	Biomedical Engineering
Spencer Rm 131B	969	BMEG 310 labs BMEG 311 design project BMEG 450	Biomedical Engineering
Spencer Rm 306 & 307	998	BMEG 450 Cell & Tissue labs, Fall 2015	Biomedical Engineering

Evans Rm 134	550	BMEG 330 labs	Electrical Engineering
"Design Studio" Spencer 1 <sup>st</sup> floor	3,500	BMEG 450	Mechanical Engineering

## Research Laboratories

Research laboratories, faculty offices, and graduate student offices for tenured and tenure-track faculty are primarily located approximately 1 mile away from the main campus in the Delaware Technology Park (DTP5, #5 Innovation Way, Newark, DE) and one laboratory is located in DuPont Hall.

To maintain communication and collaboration, the BME faculty meet regularly. A formal monthly faculty meeting, which also includes the joint, affiliated and secondary faculty, is held on main campus. An informal brown bag lunch faculty meeting is held weekly at the Delaware Technology Park. Additionally the off-site faculty share office space on the main campus for student meetings, office hours, and advising. These strategies, together with email, have established effective and cohesive communication among the BME faculty.

## VII. National and Regional Landscape

The national landscape is very clear – biomedical engineering is a degree in high demand and the vast majority of the universities offering biomedical engineering degrees have established Biomedical Engineering Departments. To be competitive in student recruitment, faculty recruitment and retention, and national rankings and reputation, it is important that the University of Delaware becomes consistent with other national and regional universities in having departmental status for Biomedical Engineering.

### Demand and Competitive Factors

The demand for admission to the UD BME undergraduate program is very high (as noted in Section IV - 3). This high demand is consistent with the popularity for the Biomedical Engineering degree across the nation, as described in the national media. Biomedical engineering is listed among the top of all majors in terms of employment outlook and job satisfaction. Forbes described biomedical engineering as number one among the most valuable college major based on starting pay, growth in pay, and opportunities, noting "*Biomedical Engineering is the major that is most worth your tuition, time and effort*" (<http://www.forbes.com>; 5/15/2012). U.S. News and World Report cited biomedical engineering first among the College Majors that Lead to Jobs and noted that "*The Bureau of Labor Statistics estimates the field will see a 62 percent growth in jobs between 2010 and 2020*" (<http://www.usnews.com/education/best-colleges/articles/2013/09/10/discover-11-hot-college-majors-that-lead-to-jobs>; 9/10/2013). Finally, CNN Money ranked biomedical engineering as first in Best Jobs in America in 2013 and 2012, noting, "*For those with a technical aptitude, it's an opportunity to make the world a better place. Every*

*day, there's the potential to create something groundbreaking"* ([http://money.cnn.com/pf/best-jobs/2013/full\\_list/](http://money.cnn.com/pf/best-jobs/2013/full_list/); 11/12/2013)

The UD BME Program competes regionally with three highly ranked BME Departments at University of Pennsylvania, Johns Hopkins University, and Columbia University. These programs are highly selective and belong to very expensive private schools. Thus, there is likely not a large impact on the UD BME Program's student demand. UD BME also competes regionally with several excellent BME Departments (e.g., Maryland, Drexel, Pittsburgh, Penn State, Virginia, and Rutgers). Importantly, despite this regional competition, UD BME attracts a number of students from Pennsylvania, New Jersey, New York, and Maryland, with 42% of our current BME enrollment coming from these 4 states. Thus, even though UD BME is young, the strength of the curriculum and program and the strength of the College of Engineering and the overall University have attracted a large number of outstanding applicants. Notably the quality of these students is very high and the demand for the BME major at UD remains exceptionally high. We expect the demand to continue growing in the coming years.

### **Aspirant, Peer, and Regional Universities**

To be a world-class Biomedical Engineering entity, UD BME will need to compete on the national landscape with the top Engineering Colleges and Biomedical Engineering Departments. All 20 of the top 20 BME undergraduate majors, ranked by US News and World Reports, have Departmental status. (In order from #1: Hopkins, Duke, MIT, Georgia Tech, UC San Diego, Stanford, Michigan, Rice, Penn, UC Berkeley, Case Western, U Washington, Northwestern, Washington U in St. Louis, Purdue, Boston U, Vanderbilt, UT Austin, U Illinois, Carnegie Mellon, Cornell, and Minnesota) Moreover, 93% of the top 40 PhD-granting Engineering Colleges have BME Departments, only two have BME Programs and one does not offer BME. While this is a correlative analysis, the current standing of UD BME as a Program places us below the standard for top tier Universities and Engineering Colleges.

At the regional level, the Universities ultimately chosen by students who were admitted to UD BME but declined our offer were (from the most to less frequently selected University): Maryland, Drexel, Pittsburgh, Penn State, Lehigh, Boston U, Virginia, SUNY Binghamton, U Connecticut, Rutgers, and Clemson. Of these, all except Lehigh have BME Departments. Indeed, in this immediate region, even Temple, Rowan, and Widener Universities have recently formed BME Departments.

Ultimately, external reporting of metrics as a Department, rather than as a Program within the Engineering College, is required to obtain appropriate national comparisons and rankings. It is indeed a great time for the University of Delaware to have a Department of Biomedical Engineering and to join the nation and the region in this opportunity.