SPECIAL REPORT

of the

ACADEMIC MATTERS, ACADEMIC PRIORITIES, GRADUATE,
PROGRAM AND BUDGET AND RESEARCH COUNCILS

concerning the

ESTABLISHMENT OF A
DEPARTMENT OF BIOMEDICAL ENGINEERING (BME)
IN THE COLLEGE OF ENGINEERING

Presented at the
758th Regular Meeting of the Faculty Senate
April 28, 2016

COUNCIL MEMBERSHIP

ACADEMIC MATTERS COUNCIL

ACADEMIC PRIORITIES COUNCIL
Faune Albert, Richard Bogartz (Chair), Nicholas Bromell, Elizabeth Chilton, Suzanne Daly, Kathleen Debevec, Jean DeMartinis, Piper Gaubatz, Bryan Harvey, Masoud Hashemi, Deborah Henson, A Yemisi Jimoh, Sangeeta Kamat, Stephen Magner, Ernest May, Katherine Newman, MJ Peterson, Monroe Rabin, James Rinderle, Peter Stern, Jack Wileden, Donna Zucker

GRADUATE COUNCIL

PROGRAM AND BUDGET COUNCIL

RESEARCH COUNCIL
The College of Engineering is proposing to create a new Department of Biomedical Engineering and associated B.S., M.S., and Ph.D. degree programs. The proposed department and degree programs are aligned with the University’s investment in life sciences, will help to meet workforce needs of the state's biomedical industry, and are expected to help with the College's efforts to bring more women into engineering and encourage interdisciplinary collaboration. The Chancellor, Provost and College have committed to providing the financial resources needed to implement the department.

At its meeting on April 6, 2016, the Academic Matters Council voted unanimously to recommend Faculty Senate approval of the proposed Department of Biomedical Engineering in the College of Engineering. It was submitted as proposal #2234 in the Course and Curriculum Management System.

HAVING PREVIOUSLY DISCUSSED WITH ENTHUSIASTIC APPROVAL THE PROPOSALS 2234, 2065, 2066, AND 2067 TO CREATE A DEPARTMENT OF BIOMEDICAL ENGINEERING AND A BS, MS, AND PH.D. PROGRAM IN THAT DEPARTMENT, AND HAVING AT THE MEETING OF FEBRUARY 25, 2016 RECEIVED ASSURANCES FROM BOTH THE CHANCELLOR, BY LETTER, AND THE PROVOST, IN PERSON, THAT THE RESOURCES TO SUPPORT THIS DEPARTMENT AND THESE PROGRAMS WOULD NOT DIMINISH THE RESOURCES AVAILABLE TO OTHER UNITS AT UMass Amherst, the Academic Priorities Council voted to endorse approval of all four proposals.

GRADUATE COUNCIL

Through an electronic vote conducted on March 2, 2016, the Academic Standards and Curriculum Committee (ASCC) of the Graduate Council voted to approve the Establishment of a Department of Biomedical Engineering (BME) in the College of Engineering.

On Wednesday, March 9, 2016, the Graduate Council unanimously approved the Establishment of a Department of Biomedical Engineering (BME) in the College of Engineering, Proposal #2234 in the Course and Curriculum Management System.

PROGRAM AND BUDGET COUNCIL

The Program Subcommittee of the Program and Budget Council met on March 9, 2016, reviewed the proposal for the Creation of a Department in Biomedical Engineering in the College of Engineering and recommended it for approval.

At its meeting on March 23, 2016, the Program and Budget Council unanimously approved the Creation of a Department of Biomedical Engineering, Proposal #2234 in the Course and Curriculum Management System.

RESEARCH COUNCIL

At its regular meeting on April 1, 2016, the Research Council voted to recommend the proposal from the College of Engineering (CoE) to create a new Department of Biomedical Engineering (BME) within that college.

Program proposals for B.S., M.S., and Ph.D. degrees in Biomedical Engineering that would be offered by the BME department are currently under review by other Faculty Senate councils. The new Department of Biomedical Engineering will be structured as other departments in the College of Engineering with a Department Head and usual faculty committees (e.g., personnel, curriculum). The Provost, Chancellor, Vice Chancellor for Research and Engagement, and the Director of the Institute of Applied Life Sciences have all endorsed this proposal and underscored the strategic alignment of this new department with campus priorities. In particular, the proposed research and graduate training space for the BME department (half located at the UMass Medical School (UMMS) in Worcester and half located on the Amherst campus) will foster collaboration with faculty on the UMMS campus, not just for BME faculty, but also for faculty, postdocs, and
graduate students in other UMass Amherst departments and programs by nature of their interactions with BME faculty. This novel arrangement of faculty research programs will serve to bridge the two campuses in a manner that hasn’t been feasible in the past. On the Amherst campus, BME faculty will benefit from the new core facilities in the Institute for Applied Life Sciences and will find many collaborations among the three research centers (Molecules to Medicine Center, Center for Bioactive Delivery, and the Center for Personalized Health Monitoring). The graduate program in Molecular and Cellular Biology, the largest interdisciplinary graduate program on the Amherst campus, already counts among its membership multiple faculty from CoE. The research goals of the BME department are complementary to those of many faculty in the MCB community, suggesting that exchanges in both directions are likely (BME faculty joining MCB and MCB students joining BME labs).

The BME program is well positioned to contribute substantially to the College of Engineering’s goal to increase the diversity of its students and faculty. Nationally, 40.6% of Bachelor’s degrees in BME are awarded to women (ASEE data, 2013-14 graduating class). In contrast, the current CoE enrollment of women is only 19.5%, which is close to the national average. Furthermore, 20.8% of BME faculty nationwide are women compared to a 15.2% average for all degree programs. The BME discipline is also well aligned with the Commonwealth’s economy as evidenced by data from the Bureau of Labor Statistics that lists Massachusetts as having the highest per capita employment of Biomedical Engineers, and almost double that of California, the 2nd ranked state. In New England, competitors in BME (ranked in the top 50 BME programs) are: the Massachusetts Institute of Technology, Boston University, Harvard University, Yale University, and Brown University. We believe that the collaboration with UMMS will enable UMass Amherst to offer a high-quality, affordable BME program that can successfully compete in the region.

MOTION: That the Faculty Senate approve the Establishment of a Department of Biomedical Engineering (BME) in the College of Engineering, as presented in Sen. Doc. No. 16-057.
Proposal to Create the Department of Biomedical Engineering

This proposal requests approval for establishing a new Department of Biomedical Engineering (BME) within the College of Engineering (CoE). This request is aligned with program proposals that have been submitted recently by the CoE to the Senate requesting approvals for B.S., M.S., and Ph.D. degrees in Biomedical Engineering. These degrees will be offered by the proposed BME department.

The new Department of Biomedical Engineering will be structured as other departments in the College of Engineering. The BME department will have a Department Head who will bear the responsibilities of assigning teaching, overseeing administrative affairs, and other necessary administrative affairs. The faculty members of the BME department will elect a personnel committee to handle personnel decisions, form a curriculum committee to supervise courses, and create other structures for internal governance. Staff members will provide administrative support for department operation, admission, pre-award and post-award grant activities, and related activities.

The attached letter of support signed by Provost Katherine Newman, Vice Chancellor for Research Mike Malone, and the Director of the Institute of Applied Life Sciences Peter Reinhart describes the strategic alignment of this new department with campus priorities. The support letter also states how targeted investments by the campus and the CoE can provide the resources necessary for hiring and supporting the faculty members and staff and general operations.

Attached to this proposal is a budget illustrating one sustainable scenario based on a steady state student body of 225 undergraduate students (total) and 75 graduate students (total). After an initial investment phase (mainly to cover startup costs), the proposed department is expected to generate substantial income for the campus starting in Year 6. It is expected that the departmental and some faculty offices will be located in CoE space. Lab space for faculty members’ research groups has not been determined, but will likely be a combination of CoE space, LSL 1 and 2 for those engaged in the Institute of Applied Life Sciences, and if needed space near the CoE (e.g., Goessmann Laboratory).

The BME program is well aligned with the College of Engineering’s goal to increase the diversity of its students and faculty. The average undergraduate enrollment of women in BME was 40.6% women (2013-14 graduating class), while the CoE enrollment of women was close to the national average of 19.5% during the same period. Furthermore, 20.8% of BME faculty are women compared to a 15.2% average for all degree programs. The BME discipline is also well aligned with the Commonwealth’s economy as evidenced by data from the Bureau of Labor Statistics that lists Massachusetts as having the highest per capita employment of Biomedical Engineers, and almost double that of California, the 2nd ranked state.

(To see the Budget, please refer to Proposal #2234 in the Course and Curriculum Management System.)
To: Members of the Faculty Senate

From: Katherine Newman (Senior Vice Chancellor and Provost)
       Mike Malone (Vice Chancellor for Research and Engagement)
       Peter Reinhart (Director, Institute for Applied Life Sciences)

Re: Biomedical Engineering department and its constituent academic programs

We write to endorse, with great enthusiasm, the plans put forward by the College of Engineering for the founding of a Department of Biomedical Engineering, and the development of three related academic programs, the BS, MS and Ph.D. in Biomedical Engineering. One of two critical goals of the strategic plan for this College (the other being Materials Science and Engineering), this new department will contribute to crucial new directions for the Amherst campus. Indeed, Biomedical Engineering rises to the top of the list of campus wide research priorities.

BME promises to be an area of growing interest to students at all levels in part because this is truly the era in which the intersection of life science and engineering is one of the most exciting developments in the academy, in industry, and for the well-being of citizens. Our students can look forward to rewarding careers involving the engineering of human tissues and the creation of new medical devices. At all levels, they will be prepared to work for some of the most creative and fast growing firms in the world, especially in New England with one of the country’s most prominent medical device clusters. They will be equally well-prepared to launch entrepreneurial ventures of their own to bring new devices to the public.

Students with BS and MS degrees will be on their way to developing the background needed to support the labor force needs projected in the life sciences. We believe they would gain access to desirable careers in companies in the northeast, from Genentech to New England BioLabs. Depending on their experience and specializations, we would hope they would contribute to the research effort in these firms and, someday, find equally rewarding employment in the Amherst region as the fruits of IALS take hold in the local economy. Nationally a significant number of BS graduates attend medical school and continue onto graduate school. Ph.D. students would be poised to enter either the academic or industry labor markets.

This initiative is a particularly important moment for our campus to launch this department because the success of the Institute for Applied Life Sciences depends in vital ways on the presence of BME faculty and graduate students. As you know, IALS has a triple mission: to advance basic life science; to develop a robust program in translational science; and to create, spin off and engage private industry in drug delivery technologies, and personalized medical device design, prototyping, and manufacturing. In all three of these IALS-prioritized areas there is a much-needed role for biomedical engineers, as engineering contributions are crucial for the translation of good ideas from campus and medical school researchers into usable products that will enable us to capture health-related data from the human body, and in some cases contribute to therapeutic interventions. Such data and devices will help to monitor conditions like diabetes and cognitive decline, prosthetic devices, and the “personalized medicine” approach to optimizing drug dosage and delivery vehicles.

Whereas all three Centers making up IALS rely on the contributions from biomedical engineers, this is perhaps most evident for the Center for Personalized Health Monitoring, the largest of three research centers in IALS, which due to its device creation, prototyping and medical device fabrication mission will depend heavily on the presence of a strong BME faculty, and just as important, will rely on a vibrant community of well-trained and creative students to develop solutions for the next generation of health care issues.

Biomedical Engineering will also form a crucial bridge to link key clinical research partners, and contribute to joint federal, state, foundation, and industry grant activities. Specific examples include collaborations with the University’s School of Medicine, both in Worcester and in Springfield. It will also be an essential partner to the
UMass medical school Center for Clinical and Translation Science (CCTS) program, recently renewed by the National Institutes of Health. Furthermore, a recent large federal center award for Flexible Hybrid Electronics includes UMass Amherst as a partner and devotes considerable attention to the area of sensing, including areas directly relevant to medical devices. We estimate this award will bring $40-50 million to Massachusetts over the next five years, 60-70% of which will be devoted to programs on our campus. Medical device manufacturing represents one of the largest areas of economic activity in the life sciences cluster in Massachusetts, where it speaks to a national priority. Historically, the Amherst campus has been under-represented in this domain. With this Flextech Alliance award, we will be on the way to ending that chapter and beginning a new one that sees our region becoming a powerhouse contributor.

Resources that will contribute to the College of Engineering and to a Biomedical Engineering focus include faculty positions, core equipment facilities, and seed-funding for translational research efforts. A further resource directly related to and enabling the creation of a BME department on this campus is the creation of more than 25 core equipment facilities, housing more than $50M of capital equipment. Many of these core facilities relate directly to BME research and to the creation of medical devices. A few BME-relevant examples of the more than 25 IALS Core Facilities are highlighted:

- **Roll-to-Roll manufacturing Facility**: providing a unique set of process and scaled manufacturing tools in an industry-accessible user facility to impact and accelerate innovation in Roll-to-Roll and printing technology for flexible hybrid electronics applications.
- **High Frequency (THz) Sensor Development Facility**: to identify biomedical applications for frequencies between microwave and infrared light (THz) with focus on non-continuous systems.
- **Sensor Integration Facility**: develops capabilities for integrated circuit packaging and prototyping. Tools and equipment are available for wafer dicing, die mounting and alignment, and wire-bonding providing a complete set of capabilities for preparing medical sensors and integrated systems for evaluation and test.
- **Advanced Digital Design (AddFab) Facility**: AddFab provides state-of-the-art 3-D printing and related digital manufacturing capabilities to support the translation of new technologies in biosensors and medical devices from lab bench to human testing. The facility allows design testing and integrated precision manufacturing capabilities directed at the medical device community.

One of the other IALS resources related to BME is the creation of a seed fund program to be implemented in 2016. This seed fund program provides funding for key translational projects such as the development and prototyping of medical devices. Two types of awards are planned – research support to acquire key data needed to advance the development of a translational concept, and support for the use of Core Equipment Facilities.

Hence, the growth and development of IALS is closely linked to the emergence of a strong BME research effort on this campus – the two initiatives are synergistic and will strengthen the biomedical presence of UMass Amherst.

Over the next two years, some 16 positions – representing joint hires between IALS and various departments, especially in Engineering, but also in Computer Science, Public Health, Natural Science and Nursing – will contribute to a vibrant BME environment on campus. The rejuvenation of Chemical Engineering, under the leadership of its new chair who is a polymer engineer, will also play a role in building BME, since this is where many of our tissue engineers are to be found. ECE as well as Mechanical Engineering are also increasingly engaged in biological research. We anticipate recruiting outstanding scientists and engineers who will take up residence in the beautiful new Life Science Laboratory.

The engineering side of the IALS equation is crucial for the translation of good ideas into usable products that will enable us to capture data from the human body to help monitor conditions like diabetes, prosthetic devices, and the “personalized medicine” approach to drug dosage. The Center for Personalized Health Monitoring, which is the largest of three research centers in IALS, will depend heavily on Biomedical Engineering for its research.

We are confident that the positions we are investing in Engineering will see the right level of educational and research benefit to make this fly. Moreover, as enrollment grows in the field, in line with the projections developed in the program proposals, we fully expect that the tuition will more than justify strategic investment in BME.
Twelve positions over five years seems entirely plausible to us if enrollment patterns continue to evolve as expected. Judging from other universities – where growth in BME is over the top – this is not hard to imagine. When students from the undergrads to the grad students learn about the opportunities at the intersection of engineering and life science, we will see the same kind of large crowd headed in their direction that other universities have witnessed.

We do not launch new departments lightly. They represent a significant investment in treasure and people. But we are absolutely sure that this is the right way to go for UMass as we seek to develop our local economy into a hub for the application of biological science. And we are confident that the return on this investment will be substantial, given the strategic importance of the biomedical industry to Massachusetts, and the access by residents of the Commonwealth to a public BME program. This vision feeds directly into the thinking of state officials who designated Western Massachusetts as the center of a regional innovation cluster in precision manufacturing. As a land-grant university, we are responsible for developing the talent and the discoveries that will make our local economy hum. Biomedical Engineering is an essential part of that vision.
November 27, 2015

Katherine Newman, Ph.D.
Senior Vice Chancellor and Provost
University of Massachusetts

Re: Founding of the Department of Biomedical Engineering (BME) and development of the BS, MS, and Ph.D. degrees in BME

Dear Katherine:

It is with overwhelming enthusiasm that I write to endorse the founding of the Department of Biomedical Engineering (BME) within the College of Engineering at the University of Massachusetts, Amherst, and the development of three new BME degree programs at the baccalaureate, masters, and doctoral levels. It is my belief that these new degrees will fill an unmet educational need for Massachusetts’ natives, and will have a strong positive impact on the workforce of the biopharmaceutical and medical device industries in the Commonwealth.

I can also confirm the enthusiastic support of our Dean of the Graduate School of Biomedical Sciences and of our key department chairs and program directors, such as those from cardiovascular medicine, cancer research, and bioinformatics, with whom you and Dean Anderson have already met. We would support the concept of our faculty serving as graduate faculty for BME students in the advanced and terminal degree programs and as laboratory mentors for students at all three levels.

We also envision strong research collaborations growing between our two campuses in the above-mentioned areas, as well as in neuroscience, which we have both recognized as a major strategic research priority, and in the area of bone regeneration within our Department of Orthopedics.

To facilitate these collaborations in research and education, we would be pleased to make available appropriate laboratory space in the Basic Science wing of the Medical School building. The laboratory space you toured during your visit would be typical of the space that is available in close proximity to all of the programs with which you would be collaborating.

Over the long term, the relationship between engineering and biomedicine has the potential to make a tremendous impact within our University and beyond. Both engineers and physicians are problem-solvers. However, I have found that engineers and biomedical scientists see problems in different ways. Putting them together can lead to creative solutions that neither one alone could ever imagined. Such inspired approaches to applied science can be the key to turning basic discoveries into cures and therapies that impact the lives of patients. An exciting prospect indeed!

Again, I am eagerly looking forward to working with you and your faculty on the BME initiative. Please call on me any time if I may be of any help.

Sincerely,

Terence R. Flotte, M.D.
Celia and Isaac Haidak Professor of Education
Dean, School of Medicine
Provost and Executive Deputy Chancellor
To: Members of the Faculty Senate

From: Kumble R. Subbaswamy, Chancellor
      Katherine Newman, Senior Vice Chancellor and Provost

Re: Proposal for Biomedical Engineering

We write to strongly endorse the plans put forward by the College of Engineering for the founding of a Department of Biomedical Engineering, and the development of three related academic programs, the BS, MS and Ph.D. in Biomedical Engineering. This new department is critical to the strategic plans for this College and will contribute significantly to crucial new directions for the Amherst campus. Indeed, Biomedical Engineering rises to the top of the list of campus wide research priorities.

In their proposal, Engineering is requesting hiring 12 tenure-track faculty members and one lecturer over six years. We support the investment in these positions. Since BME promises to be an area of growing interest to students, we expect the campus will ultimately attract approximately 60 new undergraduate students per year. The revenue generated from these students, in combination with reallocation of resources within Engineering, will fund these positions.

Based on the current budget projections, the expenses of the department will ramp up over 10 years to approximately $3.3 million per year, inclusive of the funding required to support coursework in CNS and SPHHS. The campus commits to funding $2.6 million of this support with the remainder provided by Engineering. The proposed new Department of Biomedical Engineering will be physically integrated with the University of Massachusetts Medical School (UMMS). We are projecting that most of the graduate research will occur at UMMS where they could house approximately half of the faculty in existing, high quality space. This integration will also form a crucial bridge to link key clinical research partners, and contribute to joint federal, state, foundation, and industry grant activities.

The remaining faculty will be housed on the Amherst campus. We are anticipating that these faculty will be located partially in renovated space on campus and partially in LSL as part of IALS. We have identified and committed renovation funding for vacant space that could be used for this program. The renovated space will accommodate 7-10 faculty.

We recognize that this department represents a significant campus investment at a time when new funding is limited. However, we feel certain that the strategic return to the campus will be significant and is the right way to go as we seek to develop our local economy into a hub for the application of biological science.
February 17, 2016

To: Members of the Faculty Senate

From: Timothy J. Anderson (Dean of College of Engineering)

Re: Department of Biomedical Engineering and associated degree programs

Establishment of a Department in Biomedical Engineering (BME) to offer the B.S., M.S., and Ph.D. degrees in BME is the major goal of our College’s strategic plan. We believe that these degrees are well aligned with several aspects of the university’s vision. Creation of a BME program is clearly supportive of the continuing UMass investment in the life sciences (e.g., establishment of IALS). To better connect to the UMass Medical School (UMMS), the planned BME departmental structure calls for including placement of at least half of the faculty research laboratories at the UMMS. These degree programs are also important to the state’s economy. Massachusetts has a higher percentage of current BME jobs (0.63 jobs/1000 workforce jobs) than any other state (Utah is 2nd at 0.41 jobs/1000 workforce jobs). The demand for graduates is high and expected to continue to increase. The Bureau of Labor Statistics recently reported: “Employment of biomedical engineers is projected to grow 23 percent from 2014 to 2024, much faster than the average for all occupations (7%).”

Locally in the College of Engineering, the BME program would significantly impact the number of women in our College. Of the 23 monitored engineering disciplines nationally, BME has the 2nd highest percentage of women enrollment for B.S. programs (40.8%) as well as for tenure-track faculty (20.8%). The addition of the new program would help the College further increase its faculty excellence, encourage more interdisciplinary collaboration, and better buffer the College from fluctuations in enrollment and research funding.

The BME department formation committee, which included members from the 4 Engineering departments and 4 other colleges, developed a proposal for implementing this new department that would provide a high-quality education for its students. We have worked with the Provost’s office and College partners to develop a budget model that is primarily financed by tuition and fees as well as a recurring investment by the College. A strategic investment from the University is required in years 1 and 3 through 5, primarily a result of the one-time faculty start-up costs. This investment will be fully recovered in year 6.

The College of Engineering is committed to contribute to the implementation of the BME program in the following ways:

- Administrative support to establish the BME department
- Base salary for one BME faculty member through salary recovery from retirements
- Funds for labs and TAs through the Engineering Fees
- Payment of fees to the College of Natural Sciences for lab courses taken by BME students

We firmly believe that establishing a new department of BME will benefit our students, the University, and the Commonwealth.

---
