



College of Engineering

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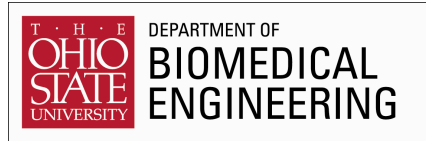
To: Randy Smith  
Vice Provost, Office of Academic Affairs

From: Ed McCaul   
Secretary, College of Engineering Committee on Academy Affairs (CCAA)

Subject: Semester Conversion Proposal for the MD-PhD Combined Degree in  
Biomedical Engineering

Attached is a letter from Richard Hart, Department Chair of Biomedical Engineering, as well as a semester conversion proposal for their MD-PhD Combined Degree program. It should also be noted that they are withdrawing their graduate interdisciplinary specialization.

This proposal was reviewed by a subcommittee of CCAA. After reviewing the proposal and having some minor changes made to it the subcommittee recommended to the full committee that it be approved. After a discussion, CCAA unanimously approved the proposal on the 11<sup>th</sup> of October 2010 and requested that I forward the proposal to you for consideration by CAA. If you have any questions concerning this proposal please let me know.



**Richard T. Hart, Ph.D.**

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July 22, 2010

On behalf of the faculty from the Department of Biomedical Engineering, I am pleased to share our plans for the transition of our curriculum from one based on 10-week quarters to the new 14-week semester calendar. The BME Undergraduate Studies Committee (USC), comprised of six faculty and staff, began discussions on the conversion process in the Fall 2009 quarter. Weekly meetings have taken place since the start of Winter 2010, with accompanying updates to the full faculty at regular meetings (every 3 weeks). Similarly, a subcommittee of the Graduate Studies Committee (GSC) worked on the transition policies of the graduate programs starting in Fall 2009 until its final approval, with updates discussed at full faculty meetings. The proposed semester undergraduate advising (BINGO) sheet was approved by the faculty on March 12, 2010. Final approval for all five proposals is listed below.

All program proposals are based on the following principles:

- Student progress toward completion of the program will not be impeded by the semester conversion, assuming the student contacted the Department before the conversion to semesters.
- All students who complete the degree requirements under the semester system must complete all requirements of the new semester program.
- Semester program requirements may be met either by taking semester courses (or sequences), or by substituting a substantially equivalent quarter course (or sequence).
- BME does not anticipate using BME “bridge courses” in the transition process. However, bridge courses may be required or suggested by other Departments, including Mathematics and Physics.
- Issues that are not specifically addressed in the proposal will be handled through the Undergraduate Studies Committee and/or the Graduate Studies Committee, to resolve the problem with the student’s best interest in mind.

We have made proposals for the following BME programs:

- BS in Biomedical Engineering
- Undergraduate Minor in Biomedical Engineering
- MS in Biomedical Engineering
- PhD in Biomedical Engineering
- M.D.-Ph.D. combined degree, with the PhD coming from Biomedical Engineering.  
**(this document)**

We have withdrawn our graduate interdisciplinary specialization.

We will follow college rules, as described in the college’s proposal for semester conversion, for the implementation of our BS/MS program, and for the policy on General Education courses within the undergraduate major program.

We requested and received feedback from our current students and the BME External Advisory Board (EAB). Student comments were generally supportive, and raised only minor issues. One student did comment on the undergraduate program that a potential overlap of

information in two of our lab courses, and we will address this issue. The EAB unanimously endorsed all proposals, with generally minor comments. One EAB member asked about the appropriateness of having only one Statistics course and an absence of any Anatomy course requirement in the graduate programs. The BME Faculty had many discussions on this issue, and the consensus was that a minimum number of required courses for all graduate students was a critical component of our new graduate curriculum. Specifically, the student and advisor(s) would best be able to develop a program of study that would include the necessary depth in statistics, anatomy, or any other area deemed important for the student and also improve the time spent on focused research.

The faculty voted on April 23, 2010 to accept and endorse the new semester-based curriculum plans for:

Undergraduate Major: 13 in favor, 0 opposed, and 0 abstaining  
Undergraduate Minor: 13 in favor, 0 opposed, and 0 abstaining

The faculty voted on May 14, 2010 to accept and endorse the new semester-based curriculum plans for:

Graduate Master's Program: 12 in favor, 0 opposed, and 0 abstaining  
Graduate Doctoral Program: 12 in favor, 0 opposed, and 0 abstaining  
Graduate MD-PhD Program: 12 in favor, 0 opposed, and 0 abstaining

Thank you, in advance, for your consideration of our plans.

Sincerely,

A handwritten signature in blue ink that reads "R.T. Hart". The signature is written in a cursive style with a large initial "R" and a distinct "T".

Richard T. Hart, Ph.D.

# Biomedical Engineering (BME) Program Proposal

Primary Contact: Mark A. Ruegsegger (Ruegsegger.1, 247-6890)

1. **Name of program**  
Biomedical Engineering
2. **Name of Degree**  
Doctor of Philosophy in Biomedical Engineering (in conjunction with completion of an MD degree through the College of Medicine)
3. **Responsible Academic Unit**  
Department of Biomedical Engineering
4. **Type of Program:**  
d. Graduate degree program
5. **Semester Conversion Designation**  
b. Converted with minimal changes to program goals and/or curricular requirements (e.g., name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)

## 6. Program Learning Goals

### BME Doctoral Program Objectives:

The objective of our biomedical engineering doctoral program is to provide educational opportunities for students to creatively integrate engineering and life sciences so that graduates can successfully pursue:

- Research or professional practice in biomedical engineering.
- Advanced study leading to research or professional practice in health care.
- Careers in biomedical engineering industries, related technical and professional fields, or begin an academic career.

## 7. List the semester courses (department, title, credit hours) that constitute the requirements and other components of the program.

The proposed semester-based requirements for the MD-PhD program in Biomedical Engineering include the following:

- BME Core Courses:
  - Introduction to Graduate Studies in BME (BME 5000) 1 semester credit hour
  - Research Design (currently STATS 641 or ChBME 779) 3 semester credit hours
  - Research Ethics (BME 6983) 2 semester credit hours
  - BME Seminar 2 semester credit hours

(BME 8881)

- BME Domains: The OSU BME department has Faculty expertise in five (5) domain areas within the discipline
  - Bioimaging
  - Biomechanics and Transport
  - Biomaterials
  - Molecular, Cellular and Tissue Engineering
  - Micro- / Nano-Biotechnology and Medical Device Design

Students must take the following sequence of Domain courses:

- Two fundamental BME courses in a 'major' domain (6 sem cr-hrs);
  - Two advanced courses in their 'major' domain (6 sem cr-hrs). These can be BME or outside courses.
  - The students "minor" domain, two courses (6 sem cr-hrs), will be satisfied through medical school courses in their medical area of interest, expected to be the application area for their research.
- Engineering Electives: Two (2) additional courses (6 semester credit hours) in Engineering, chosen with the assistance of the student's research advisor and their departmental core faculty contact, to round out the student's program. This requirement allows development of additional breadth and/or increased depth to create a program focused on the individual student and their career objectives.
  - Sufficient semester credit hours of Research to meet the Graduate School's credit hour requirement for a Ph.D. (80 sem cr-hrs for course and research) culminating in the preparation and defense of a dissertation.
  - Submission of two (2) manuscripts for publication in recognized scientific journals (e.g. indexed by ISI). The student should be the first author on at least one of these manuscripts.
  - Presentation of at least one (1) oral or poster presentation at a regional, national, or international meeting

## **8. Current and Proposed Curriculum Advising Sheets**

All programs of study are individually reviewed and approved by the BME Graduate Studies Committee during the student's first year in the program. Any subsequent changes and modifications are also submitted to and approved by the GSC. The GSC considers all special circumstances and petitions for variance from students and their advisors.

Prior to signing the “Request to Graduate” form, the program is again reviewed by the Graduate Studies Coordinator for completeness and compliance with program requirements.

The Advising Sheet shown below serves as the template for advising students on program issues and course selection. The Biomedical Engineering graduate courses offered are listed in Appendix A. The current PhD curriculum advising sheet is provided in Appendix B.

**BME MD/PhD program – sample curriculum**

YEAR	FALL	SPRING	SUMMER
1	Intro to BME.....1____ Research Ethics .....2____ Research Design .....3____ BME Seminar .....0____ Major Domain #1 .....3____ TOTAL = 9	Major Domain #2 .....3____ Major Domain #3 .....3____ BME Seminar .....1____ Research .....3____ TOTAL = 10	Research .....12____ TOTAL = 12
2	Medical School – Year 1	Medical School – Year 1	
3	Medical School – Year 2	Medical School – Year 2	
4	Major Domain #4 .....3____ Eng. Elective #1 .....3____ Eng. Elective #2 .....3____ BME Seminar .....0____ Research .....3____ TOTAL = 12	BME Seminar .....1____ Research .....9____ CANDIDACY EXAM TOTAL = 10	Research .....3____ TOTAL = 3
5	Research .....3____ TOTAL = 3	Research .....3____ TOTAL = 3	Research .....3____ TOTAL = 3
6	Research .....3____ TOTAL = 3	Research .....3____ TOTAL = 3	
7	Medical School – Year 3	Medical School – Year 3	
8	Medical School – Year 4	Medical School – Year 4	

Total Hours = 80+

[26 PhD course cr-hrs, 9+ Medical School course cr-hrs; 45 Research cr-hrs]

Candidacy Examination will be taken at the completion of all the courses in the student’s program of study. In this sample curriculum, that would be at the end of their second year in the Graduate Program (Year 4).

This program is 9 course credit hours shorter than the stand-alone PhD program in BME as the Physiology course is no longer required and the Engineering minor has been waived. Additionally, summer research is decreased to accommodate the July start of PGY3 medical rotations. The Life Science curriculum in the MD program adequately covers the material so a student who has completed the first year of the Medical School curriculum will be assumed to have adequate Life Science background.

## **9. Curriculum Map Showing Attainment of Program Learning Outcomes**

Not applicable for the MD-PhD program

## **10. Rationale for Program Changes and Description of Changes**

Biomedical Engineering has had a graduate degree program since 1971 and undertook a systematic review of all its educational offerings when we became a department in October 2006.

The full BME Faculty began discussions of a revised doctoral program in September, 2008 and spent academic year reviewing and revising our program philosophy, practices, and core competencies. A subcommittee of the Graduate Studies Committee (GSC), began to work on a revised program of study last Spring and continued through the summer. Student (MD-PhD graduates) and External Advisory Board input was requested and received, with comments being generally positive and only minor issues identified. The full faculty discussed the proposal through the Autumn and Winter Quarters, making suggestions and clarifications, before finally voting to approve the proposal on May 14, 2010. The proposal included both modifications to the Quarter-based doctoral program and the changes made necessary by the upcoming conversion to a semester calendar.

In the program revision and the conversion to semesters, the following program changes were made:

- The program's historical flexibility was maintained but a more prescribed definition of the areas of concentration ("majors" and "minors") was implemented.
- The minimum number of Life Science courses was eliminated in favor of allowing each student, and their advisors, to determine an appropriate balance to achieve the student's educational and career objectives.
- Two new requirements – Research Ethics and Research Design – were made explicit.
- A new course – Introduction to Graduate Education in BME – was conceived and developed to teach the essential skills necessary for success as a graduate student in a research-focused discipline. These include literature

search techniques, critical evaluation of the literature, preparation of abstracts, proposals and manuscripts, and presentation of research results.

**11. Provide a table to aid the Council on Academic Affairs reviewers as they check for credit hour changes.**

	A.) Number of credit hours in current program	B.) Calculated result for 2/3 of current quarter credit hours	C.) Number of credit hours required for proposed program
Total cr-hrs required for completion of program <sup>1</sup>	120	80	80
Prerequisite cr-hrs required for admission to program which are not counted toward total hours	0	0	0
Required cr-hrs offered by the unit <sup>2</sup>	96 – 110	64 - 74	62 - 68
Required cr-hrs offered outside of the unit <sup>3</sup>	10 – 24	6 – 16	12 - 18

<sup>1</sup> This table includes the PhD portion of the MD/PhD program, and includes 9 credits of Medical School course credit hours to provide the total of 80 credit hours.

<sup>2</sup> The total number of required hours includes the 70 qtr cr-hrs and 45 sem cr-hrs, respectively, of BME Research credits.

<sup>3</sup> The current and proposed BME MD-PhD program permits student-defined areas of concentration that can include a substantial number of courses from across the College of Engineering and usually also include courses from other disciplines, particularly Life Sciences. The distribution from BME, the CoE, and other units varies with each student's program.

**12. Rationale for a Significant Change in Credit Hours (more than 4 cr-hrs)**

The increase in 'required cr-hrs offered outside the unit' in Column C comes from the extra Medical School courses that are counted toward the BME 'minor' domain. This provides beneficial course efficiency for the student, and is an integral part of the University's application for NIH training grants for the MSP program.

**13. Transition Policy**

As stated in the cover letter, the Department is committed to ensuring that student progress toward graduation is not impeded by the conversion to semesters.



The transition policy is based on the following principles:

- All student programs are reviewed and approved by the Graduate Studies Committee, which will work to resolve the problem with the student's best interest in mind.
- Students will be encouraged to meet with their advisors and the Graduate Studies coordinator before Winter 2012 to ensure a smooth transition into semesters.
- The GSC will be proactive in anticipating issues that arise in student programs during the transition process and will actively advise students to minimize problems.

As each student's program is unique, specific, class-by-class transitions plans are not necessary on the graduate level as they are for undergraduate programs. The BME graduate program has about 50 graduate students, of which 2-3 students are typically in the MD-PhD program. Individual meetings will be encouraged for all graduate students affected by the conversion. GSC will continue to work closely with the Academic Office of the Medical School to ensure a smooth transition for students in this program.

#### **14. Assessment Practices.**

Currently, all BME courses are assessed through a variety of mechanisms:

- a. Assignments, exams and other metrics in the course
- b. Student evaluations of the course (anonymous, BME-initiated zoomerang survey) and instructor (eSEI).
- c. Quarterly course round-ups, where Faculty meet to discuss the strength and weaknesses, successes and deficiencies of all the courses just completed. A Continuous Quality Improvement (CQI) assessment plan is generated that documents strategies intended to improve the course for the next offering.

We do not anticipate that we will need to modify our current assessment practices after conversion to semesters.

#### **15. Assessment Plan on File with OAA.**

The assessment plan for the BME undergraduate program has been submitted on the OAA survey form. Though such a plan is not required for graduate programs yet, all courses in the department that can be taken by undergraduates will be assessed as described in that plan.

**Appendix A: BME MD-PhD program - Semester Course List by Domain**

<b>BME Graduate Course</b>	<b>Course Number</b>	<b>Hours</b>
<b>Required Courses</b>		
Intro to BME Graduate Studies	BME 5000	1
Research Ethics	BME 6983	2
<b>Bioimaging</b>		
Biomed Microscopic Imaging	BME 5110	3
Biomedical Optics	BME 5120	3
Biomedical Ultrasound	BME 5186	3
Ophthalmic Engineering	BME 6115	3
<b>Biotransport and Biomechanics</b>		
Advanced Biotransport	BME 5210	3
Mechanobiology	BME 5420	3
Tissue Mechanics	BME 5421	3
Finite Element Analysis Applications in BME	BME 5430	3
Cellular Mechanics	BME 5470	3
Biofluid Dynamics of Phys Systems	BME 5475	3
Orthopaedic Engineering	BME 6479	3
<b>Biomaterials</b>		
Advanced Biomaterials	BME 5310	3
Biopolymer Structure and Function	BME 5359	3
Soft-Tissue Biomaterials	BME 5352	3
Hard-Tissue Biomaterials	BME 5353	3
<b>Molecular, Cell and Tissue Engineering</b>		
Advanced Tissue Engineering	BME 5510	3
Cell Engineering	BME 5520	3
<b>Micro/Nanotechnology &amp; Devices</b>		
Biomedical Microdevices	BME 5610	3
Medical Devices and Design	BME 5639	3
Biomedical Nanotechnology	BME 5661	3
Advanced Biomedical Nanotechnology	BME 5662	3
Micro and Nano Fluidics	BME 5663	3
Cellular Nanotech	BME 5665	3
BioMEMS Microfabrication	BME 5667	3
Biomedical Transducers	BME 5668	3
Advanced Medical Devices and Design	BME 5669	3
<b>Non-Domain Courses</b>		
Cardiovascular Bioengineering	BME 5001	3
Biocompatibility	BME 6934	1
Biomedical Instrumentation	BME 5771	3

**Appendix B: BME MD-PhD (Quarter system) Advising Sheet**

Student Name \_\_\_\_\_

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**FIRST SECTION**

**I. MAJOR:** \_\_\_\_\_

Advisor		Co-Supervisor

Advisor Signature of Approval		Co-Supervisor Signature of Approval

**A.**

Dept. Name	Course Num.	Course Title	Credit Hours	Type

**B. Major Total Credit Hours:**     \_\_\_ (25 hours required)

**II. MINOR 1:** \_\_\_\_\_

Supervisor		Supervisor Signature of Approval

**A.**

Dept. Name	Course Num.	Course Title	Credit Hours	Type

**B. Minor 1 Total Credit Hours:** \_\_\_\_ (12 hours required)

**IV. OTHER COURSES**

**A.**

Dept. Name	Course Num.	Course Title	Credit Hours	Type

**B. Other Courses Total Credit Hours:** \_\_\_\_

**Total Credit Hours:** \_\_\_\_\_

**SECOND SECTION**

**I. ENGINEERING**

Dept. Name	Course Number and Title	S/U Graded	600-700 lev.	800-900 lev.

**Total Engineering Credit Hours: \_\_\_ (40 hours required)**

**II. LIFE SCIENCES**

Dept. Name	Course Number and Title	S/U Graded	600-700 lev.	800-900 lev.

**Total Life Science Credit Hours: \_\_\_ (25 hours required)**

**III. OTHER**

Dept. Name	Course Number and Title	S/U Graded	600-700 lev.	800-900 lev.

**Total Other Credit Hours: \_\_\_ (10 hours required)**

**SUBTOTALS**

**Total Number of Credit Hours of Letter-graded Courses : \_\_\_ (60 hours required)**  
**Total Number of Course Hours: \_\_\_ (75 hours required)**

**IV. BME 881 02**  
**V. BME 999 50**