

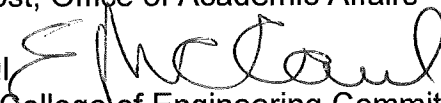


College of Engineering

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Date: 9 September 2010

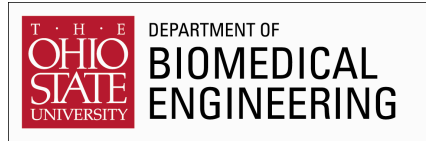
To: Randy Smith
Vice Provost, Office of Academic Affairs

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

Subject: Semester Conversion Proposals for Biomedical Engineering's BS/MS Program and their MS Degree in Biomedical Engineering

Attached is a letter from Richard Hart, Department Chair of Biomedical Medical Engineering, as well as semester conversion proposals for their BS/MS program and their MS in Biomedical Engineering Degree. It should be noted that their BS/MS program is only mentioned in Richard Hart's cover letter as they plan on following the college's rules in regard to this program.

These proposals were reviewed by a subcommittee of CCAA. After reviewing the proposals and having some changes made to the MS proposal the subcommittee recommended to the full committee that they be approved. After a discussion, CCAA unanimously approved the proposals on the 8th of September 2010 and requested that I forward the proposals to you for consideration by CAA. If you have any questions concerning these proposals please let me know.



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

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 "H".

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**
Masters of Science in Biomedical Engineering
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 Masters Program Objectives:

The objective of our biomedical engineering Masters 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 or related technical and professional fields.

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

The Biomedical Engineering graduate courses offered are listed in Appendix A. The proposed semester-based requirements for the thesis and non-thesis MS programs 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 (BME 8881) 1 semester credit hour
 - Human Physiology 3 semester credit hours

(currently Physio 601 or 602)
(Students with adequate Physiology background may
substitute anatomy – currently taught as Anatomy 720)

- **BME Domains:** The OSU BME department has faculty expertise in five (5) domain areas within the discipline. Students must take three (3) BME courses in one departmental domain (9 semester credit hours)
 - Bioimaging
 - Biomechanics and Transport
 - Biomaterials
 - Molecular, Cellular and Tissue Engineering
 - Micro- / Nano-Biotechnology and Medical Device Design
- **Free Electives:** These courses will be chosen with the assistance of the student's research advisor and their departmental core faculty contact. This requirement allows development of additional breadth and/or increased depth to create a program focused on the individual student and their career objectives.
 - Thesis: A minimum of two additional courses (6 semester credit hours) in either Engineering or Life Sciences, chosen with the assistance of the student's research advisor and their departmental core faculty contact, to round out the student's program.
 - Non-thesis: A minimum of four additional courses (12 semester credit hours) in the following areas: Engineering (1 course), Life Sciences (1 course), and Open elective (2 courses).
- Thesis MS only: Six (6) semester credit hours of Research culminating in the preparation and defense of a thesis.
- Thesis MS only: Submission of one (1) manuscript for publication in recognized scientific journals (e.g. indexed by ISI).
- Thesis MS only: 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 for the Thesis (Table 1) and non-Thesis (Table 2) options. The current MS curriculum advising sheet is provided in Appendix B.

Table 1. BME Masters program (Thesis) – sample curriculum

YEAR	FALL	SPRING	May/Summer
1	Intro to BME 1__	Physiology 3__	Elective #2..... 3__ Research 3__
	Research Ethics 2__	Elective #1 3__	
	Research Design 3__	Major Domain #3..... 3__	
	BME Seminar 0__	BME Seminar 1__	
	Major Domain #1 3__	Research 3__	
	Major Domain #2 3__		
	TOTAL = 12	TOTAL = 13	

Total Hours = 31 [25 course hours; 6 research hours]

Table 2. BME Masters program (non-Thesis) – sample curriculum

YEAR	FALL	SPRING	May/Summer
1	Intro to BME 1__	Physiology 3__	Elective #3..... 3__ Elective #4..... 3__
	Research Ethics 2__	Elective #1 3__	
	Research Design 3__	Major Domain #3..... 3__	
	BME Seminar 0__	BME Seminar 1__	
	Major Domain #1 3__	Elective #2..... 3__	
	Major Domain #2 3__		
	TOTAL = 12	TOTAL = 13	

Total Hours = 31 [31 course hours]

9. Curriculum Map Showing Attainment of Program Learning Outcomes

Not applicable for the MS programs.

10. Rationale for Program Changes and Description of Changes

Biomedical Engineering has had a MS 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 graduate 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), developed the new MS programs. The proposal included both modifications to the Quarter-based Masters program and the changes made necessary by the upcoming conversion to a semester calendar. The full faculty voted to approve the Thesis MS plan on April 23, 2010. The non-thesis MS plan was voted on and approved on June 4, 2010.

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

- The MS programs will consist of 31 semester credit hours. The non-thesis MS will be all course credits, and the thesis MS will have 6 Research credit hours and 25 course credit hours.
- The MS program of study (particularly the non-thesis option) has been redesigned so that the coursework could be completed in as little as one year. This change came about after GSC and Faculty discussions and feedback from local companies (e.g. Battelle) interested in sending workers to complete a MS degree in Biomedical Engineering. It is anticipated that the thesis MS will still take 1.5 - 2 years, as is currently the average in BME.
- The program's historical flexibility was maintained but a more prescribed definition of the areas of concentration 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.

BME is fully aware that the proposed MS programs have a minimum requirement of 25 (Thesis) and 31 (non-Thesis) semester course credit hours, while the PhD program has a minimum of 35 course credit hours. This was thoroughly discussed by the Faculty and approved. Masters students need the higher number of courses to ensure suitable depth, particularly for the non-thesis option where there is not a research component.

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	45	30	31
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 ^{1,2}	26 - 35	17 - 23	16 - 25
Required cr-hrs offered outside of the unit ²	10 - 19	7 - 13	6-15

¹ The total number of required hours includes the 9 qtr cr-hrs and 6 sem cr-hrs, respectively, of BME Research credits. Additionally, this Table applies to both the Thesis and non-Thesis programs, as the difference in credits in each program (6 research cr-hrs vs 6 extra course cr-hrs) are accounted for in the cr-hr ranges.

² The current BME Masters 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)

There is not a significant change in total credit hours for this 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. All students affected by the semester conversion will be encouraged to meet individually with the Graduate Studies Coordinator.

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, all courses in the department that can be taken by undergraduates will be assessed as described in that plan.

Appendix A: BME MS program - Semester Course List by Domain

BME Graduate Course	Course Number	Hours
Required Courses		
Intro to BME Graduate Studies	BME 5000	1
Research Ethics	BME 6983	2
Bioimaging		
Biomed Microscopic Imaging	BME 5110	3
Biomedical Optics	BME 5120	3
Biomedical Ultrasound	BME 5186	3
Ophthalmic Engineering	BME 6115	3
Biotransport and Biomechanics		
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
Biomaterials		
Advanced Biomaterials	BME 5310	3
Biopolymer Structure and Function	BME 5359	3
Soft-Tissue Biomaterials	BME 5352	3
Hard-Tissue Biomaterials	BME 5353	3
Molecular, Cell and Tissue Engineering		
Advanced Tissue Engineering	BME 5510	3
Cell Engineering	BME 5520	3
Micro/Nanotechnology & Devices		
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
Non-Domain Courses		
Cardiovascular Bioengineering	BME 5001	3
Biocompatibility	BME 6934	1
Biomedical Instrumentation	BME 5771	3

Appendix B: BME Masters (Quarter system) Advising Sheet

Student Name							
Advisor Name		Supervisor Name					
Undergraduate major:							
	<u>COURSES</u> ⁽¹⁾	<u>CREDIT HOURS</u>					
		<u>A-E Graded</u>		<u>S/U Graded</u>			
		<u>500⁽²⁾-600 level</u>	<u>700-900 level⁽³⁾</u>	<u>BME 793</u>			
I	<u>Engineering Courses:</u>						
	BME 600 Introduction to BME	3					
	BME 771 Biomedical Instrumentation	3					
	Subtotals:	(a)	(b)	(c)			
		Subtotal (Engineering) a+b+c =			(18)⁽⁴⁾		
II	<u>Life Science Courses:</u>						
	Physiol 601/602 Organ Sys. Phys.	10					
	Subtotals:	(d)	(e)				
		Subtotal (Life Science) d+e =			(13)		
II	<u>Other Courses:</u>						
	Subtotals:	(f)	(g)				
	Course Subtotals:				(15)		
		(A) 500-600 level Letter-Graded A = a+d+f		(B) 700-800 level Letter-Graded B = b+e+g		(C) BME 793	
		Total A+B+C =			(36)		
Biomedical Engineering 881 - Seminar		(2)					
Biomedical Engineering 999 - Research		(9)					

Student's Signature: _____ **Date:** _____

Advisor Approval: _____ **Date:** _____

Signature of Student's Coadvisor

Supervisor Approval: _____ **Date:** _____

Signature of Student's Coadvisor

BMEGSC Approval: _____ **Date:** _____

Signature of Graduate Studies Chair

- (1) Include course titles. Individual and group studies topics should be given with the course listing.
- (2) See Curriculum Guidelines, p. 3, for admissibility of 500-level courses. Courses at and below the 400-level need not be included.
- (3) Exclusive of 999 hours.
- (4) Fill in left side of Subtotal and Total boxes. Minimum recommended requirements are indicated to the right. Satisfaction of these requirements is not sufficient for program approval. All programs must be approved by the BME Studies Committee.