

Dr. Blackwell:

Thank you for your insightful comments. I am providing comments to these questions below.

- 1) We still do not quite understand the rationale for the changes to your program. You say that you aim to achieve a high-quality curriculum for your students "with an emphasis on four components: Hands-on experiences, Technical communication, Modeling or simulation, and Creativity." And then the proposal proceeds to delineate which courses are being added and which dropped but it does not explain how the adding and dropping of these courses a) improves the program and b) is linked with the four goals mentioned above.

Your point is well taken. The four components that we are emphasizing are not actually the rationale for the changes, but more the goal for the curriculum product. As a multi-disciplinary program, we have a distinction that many of our junior and senior level courses integrate many engineering and life science principles into a unified teaching experience, using these four instructional components. So, the original curriculum we developed 4 years ago included these components, and it is our goal to maintain these 4 components in our current semester-converted curriculum. So, you could say that our rationale for changes to the program is to create a semester curriculum that will preserve these 4 learning components. I will reword some of the rationale to reflect this thinking.

- 2) We note that on your curriculum map, many of your program outcomes are met and at a more advanced level in courses numbered 2010 through 4510 whereas the higher numbered courses including courses on the 5000-level meet fewer of the program outcomes and, in particular, that 5420 meets six of the outcomes at a beginning level. The more natural progression would seem to be that lower-numbered courses would meet outcomes at a beginning level and higher numbered ones at an advanced level. Can you explain?

The level at which a program outcome is taught (i.e. the number of stars), does not necessarily reflect the depth at which the content is taught. For our Dept, the number of asterisks reflect the amount of content associated with a given program outcome, not the depth of content. The higher course number is a better indicator of how advanced the content will be. So, a sophomore-level course may spend half the semester on topics pertaining to program outcome 'c', indicated by 3 asterisks (\*\*\*), but the instruction may be at an introductory level. Then, an advanced course may contain 3 weeks of instruction pertaining to program outcome 'c', indicated by one asterisk (\*), but the instruction will be at a more advanced level.

In the CoE Online Syllabus program, the asterisks represent hours (not depth), with the following scale:

- 0 \*: No contribution to a program outcome
- 1 \*: Some contribution to a program outcome (1-2 hours)
- 2 \*: Substantial contribution to a program outcome (3-6 hours)

3 \*: Significant contribution to a program outcome (7+ hours)

So, our selection of program outcomes and levels reflects how much content of the course is spent on a given program outcome, not necessarily the depth.

3) p. 3 the line that begins "ANAT 2200": If you add the phrase "for our purposes" or something similar after the word "merges," it will be clear, as it was not on an initial reading, that the two courses of which you speak, ANAT 220 and EEOB 232 are in fact merging but rather that you are allowing the new ANAT 2200 to fulfill the requirement that both those courses previously filled in your program.

The content of EEOB 232 will now be taught in ANAT 2200. Accordingly, we increased the cr hrs of the ANAT 2200 to accommodate the expanded content. I will reword this section to clarify that the instructor of ANAT 220 is willing to teach both the Anatomy and Physiology content in an expanded course, ANAT 2200.

4) p. 3 last paragraph: We suggest dropping the "(i.e. pre-med)." Any pre-med students would need substantially more and higher chemistry than the 245 to which you allude. We recommend instead that you simply advise pre-med majors to consult specifically pre-med advisors about which chemistry courses to take.

The parenthetical has been removed.

And lastly a minor error:

p. 3 "complimentary" should be "complementary"

This has been corrected.



College of Engineering

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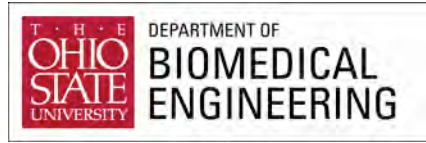
To: Randy Smith  
Vice Provost, Office of Academic Affairs

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

Subject: Semester Conversion Proposals for BS in Biomedical Engineering

Attached is a letter from Richard Hart, Department Chair of Mechanical Engineering, as well as a semester conversion proposal for the BS in Biomedical Engineering Degree.

This proposal was reviewed by a subcommittee of CCAA. After reviewing the proposal and having some 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 30<sup>th</sup> of July 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.



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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 (**this document**)
- 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.

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 "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**  
Bachelor of Science in Biomedical Engineering
3. **Responsible Academic Unit**  
Department of Biomedical Engineering
4. **Type of Program:**
  - a. Undergraduate bachelors degree program
5. **Semester Conversion Designation**
  - a. Re-envisioned with significant changes to program goals and/or curricular requirements (e.g., changes in program goals, changes in core requirements, structural changes to tracks / options / courses)
6. **Program Learning Goals**

## BME Undergraduate Program Objectives:

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

- Advanced study leading to 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.

## BME Undergraduate Program Outcomes:

Graduates from the biomedical engineering program will have demonstrated that they possess the ability to:

- (a) Apply knowledge of mathematics, science, and engineering
- (b) Design and conduct experiments, as well as analyze and interpret data
- (c) Design a system, component, or process to meet desired needs
- (d) Function on multi-disciplinary teams
- (e) Identify, formulate, and solve engineering problems
- (f) Understand professional and ethical responsibility
- (g) Communicate effectively
- (h) Understand the impact of engineering solutions in a global and societal context
- (i) Recognize the need to engage in life-long learning
- (j) Demonstrate knowledge of contemporary issues

- (k) Use the techniques, skills, and modern engineering tools necessary for engineering practice
- (l) Solve problems at the interface of engineering and biology
- (m) Measure and interpret data from living systems.

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

The proposed semester-based curriculum list is presented in Appendix A, and has the following notable features:

- At least initially, BME courses will be taught once per year. As will be explained in the Transition Policy (#13), we will be actively advising our students how to select courses in the pre-conversion years so that this will not be a constraint for progress toward graduation.
- Students will take three (3) BME Domain Courses in the junior year that they select from a list of six (6) courses. These courses provide **breadth** in several fields of biomedical engineering, but also provide the platform to develop **depth** in the Domain that interests them most. In the Senior year, they will take two (2) graduate-level BME Advanced Courses that are within their selected Domain.
- Students will choose three (3) Technical Electives in their junior and senior years, which provide a mechanism to tailor their curriculum to their career goals. Technical Electives must be 3000-level or above, or on the BME approved list (to be created after final course numbers are developed). Two of the courses must be engineering courses (to complete ABET requirements), while the third course could be outside of engineering. We will advise pre-professional students (med, vet, etc) to apply one of their pre-med requirements toward this Elective. Also, all students would have an option to taking an additional Domain course.

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

The current and proposed curriculum advising sheets (i.e. BINGO sheets) are presented in Appendices B and C, respectively.

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

The curriculum map of the BME undergraduate program learning outcomes is presented in Appendix D.

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

Biomedical Engineering became a department in October 2006, and the inaugural class of 16 sophomores started the BME undergraduate bachelors degree program in Winter 2009. The current quarter-based curriculum had been carefully constructed

by the Faculty to achieve a high-quality curriculum for our students, with an emphasis on four components: Hands-on experiences, Technical communication, Modeling or simulation, and Creativity. One of our priorities in the conversion process is to ensure that these components are maintained in the new curriculum. So, our rationale for changes to the curriculum reflects the balance between maintaining a high-quality curriculum and the constraints of staying close to credit neutral. The feedback we received from students, Faculty and external sources was used to guide us in changing and improving the curriculum.

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 bi-weekly meetings. The proposed semester advising (BINGO) sheet was approved by the Faculty on March 12, 2010.

The semester conversion proposal for the BME major program was approved by the Faculty on April 23, 2010.

In the conversion to semesters, the following program changes were required:

- Changes to the General Education (GE) requirements were made and stipulate that 24 semester credits of GE will be required by all engineering major programs. BME will follow college rules in regards to GE courses.
- The Engineering Core was significantly reduced to include fewer common courses across the engineering programs. BME has incorporated these changes into the proposed curriculum.
- Two new courses were created by merging courses with complementary content.
  1. **ANAT 2200**: This course will be a newly created, expanded course that merges the content of ANAT 220 (2 qtr cr hr) and EEOB 232 (5 qtr cr hr). The instructor of the ANAT 220 course, Prof. John Bolte, has already agreed to this change, and is working with BME and colleagues in Anatomy to develop the new physiology material that will be added into the current Anatomy course. This will be a credit neutral course: 4 sem cr-hr  $\approx$  7 qtr cr-hr courses.
  2. **ME 2040**: The quarter courses, ME 410 and ME 420, are both required courses within the BME curriculum. This new, merged course was agreed upon after discussions between ME and at least 5 other engineering departments. ME collected suggestions for topics from all interested departments, and BME is satisfied with the content of the new course. This course will have a slight reduction in overall credits: 4 sem cr-hr < 8 qtr cr-hr courses.
- Three courses were dropped. Faculty decisions were based on discussions of which courses (or topics within courses) were essential for all biomedical



engineers to take, and which were not. The courses dropped and additional explanation are provided below:

1. **Chem 245:** BME decided that this course, Organic Chemistry Lab I, was useful for some Domains, but not others. Students wanting to take this course could do so and count it toward their Technical Electives. Chemistry was informed that BME would not continue taking the course after the semester conversion.
2. **ECE 300/309:** The Circuits and Circuits Lab courses were removed from the semester curriculum after lengthy Faculty discussions. It was discovered that none of the BME Domain courses required ECE 300/309 as a pre-requisite course, and the only BME course that did require ECE 300/309 was the 2 qtr cr-hr course, BME 402:Measurements and Instrumentation. BME decided to increase the credits of the BME 402 course from 2 qtr cr-hr to 2 sem cr-hr, and teach the necessary background circuits information in the course. ECE was informed of our decision to discontinue ECE 300/309 after semester conversion. However, we anticipate that many of our BME students (possibly  $\frac{1}{4}$  to  $\frac{1}{2}$ ) will take ECE 300/309 as a Technical Elective.
3. **BME 581:** This year-long seminar-based course series provides students the opportunity to engage in the BME community by listening to and interacting with speakers presenting cutting-edge biomedical research. BME decided to incorporate the seminar requirement within the senior-level course, BME 503:Professional Development, rather than continue as a stand-alone seminar course.

The Transition Policy (#13) describes in detail how BME will help students navigate through the merged and dropped courses.

- The proposed semester curriculum includes greater flexibility in student choices of courses, specifically in the Technical Electives. Currently, students take three (3) Technical Electives, but are limited to courses offered within the College of Engineering (for ABET purposes). The new curriculum also requires three (3) Technical Electives, but only requires that two courses be within engineering. The third course can be from any unit. This increased flexibility of course selection will be particularly helpful for the pre-professional students.

**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	193	129	132

completion of program			
Required cr-hrs offered by the unit*	40-49	27-33	32-41
Required cr-hrs offered outside of the unit*	144-153	96-102	91-100
Free elective cr-hrs	0	0	0

\* The range of credit hours reflects 9 credit hours of Technical Electives that a junior- or senior-level BME student may choose to take within Biomedical Engineering or outside the unit.

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

There is a small shift for increased credit hours for the second row, "Required cr-hrs offered by the unit." The number of courses required within BME actually decreases from 13 to 12 courses in the semester curriculum. However, there are four courses that will convert from 4 quarter cr-hrs to 3 semester cr-hrs, and two courses (BME Advanced courses) that will convert from 3 quarter cr-hrs to 3 semester cr-hrs. These fractional increases in credit hours accounts for the majority of the shift in credits after semester conversion.

### 13. Transition Policy

As stated in the cover letter, the Chair, along with all Faculty, is committed to ensuring that student progress toward graduation is not impeded by the conversion to semesters.

It is imperative that students meet all ABET requirements regardless of any combination of quarter- and semester-based courses. Appendix E shows how our new proposed curriculum, in all combinations with the current quarter curriculum, will satisfy ABET requirements for engineering and math/science courses for all classes involved in the transition.

BME will be proactive in anticipating issues specific to each class during the transition process. BME advisors will meet individually with each student that will be affected by the semester conversion at least one year before the transition takes place in Summer 2012. We discuss below the identified, potential issues for BME students in Fall 2012 by class:

#### **Freshman class:**

There are no anticipated transition issues, as these students are just entering the University. Any AP courses will transfer in under a new transfer policy that the University has in place. We will make sure that they are only seeing the new semester BINGO sheet with any materials they receive during the recruitment and orientation process.

**Sophomore class:**

There are several transition issues, particularly with the year-long sequences in Physics, Math and Chemistry in the Freshman year (quarter system).

1. If students have taken (a) Math 151 or (b) Math 151 and Math 152, should they be allowed to take semester 'Engineering Calculus 2' or not? For situation (b), would students still have to take semester 'Engineering Calculus II'? Also, students need to get through Math 254 in their freshman year, so they can take semester Math 3 in the Fall of sophomore year.

Transition Plan: A MOU has been signed between CoE and the Math Department to help guide the conversion process for students. Students may be advised to take a bridge course to allow students to take Math 3 in the Fall semester.

2. If students have taken (a) Phys 131 or (b) Phys 131 and Phys 132, should they be allowed to take semester 'Phys 2' or not? For situation (b), would students still have to take semester 'Phys 2'?

Transition Plan: Students who have taken only Physics 131 will be advised to take the semester Physics 2 course. Students who have taken both Physics 131 and 132, may be advised to take the 1 cr hr semester bridge course offered by the Physics department. Once we see the material in the bridge course, then BME will decide which path to take.

3. If students have taken (a) Chem 121 or (b) Chem 121 and Chem 122, should they be allowed to take semester 'Chem 2' or not? For situation (b), would students still have to take semester 'Chem 2'?

Transition Plan: Students will be strongly advised to complete the full Chem 121-123 sequence in the quarter system. A complete transition plan is still being worked out with the Chemistry Department, which may include a bridge course for students who did not complete the Chem 121-123 sequence under the quarter system.

4. (Unlikely scenario) If a student has taken ME 410, but not ME 420, would BME still require that they take semester 'ME 410/420'?

Transition Plan: Students will be actively advised to NOT take ME 410 in the Freshman year, but to wait until after semester conversion to take the combined course. If a student does take ME 410 prior to Fall 2012, they will need to take ME 2020 in the Fall, which will be offered as a separate course.

5. (Unlikely scenario) If students have taken EEOB 232, but not ANAT 220, would BME still require that they take ANAT 2200?

Transition Plan: Students will be actively advised to NOT take EEOB 232 in the Freshman year, but to wait until after semester conversion to take the combined course. Students will be informed that if they do take EEOB 232 prior to Fall 2012, they will need to take the semester ANAT 2200.

**Junior class:**

There are several transition issues, particularly with the Engineering service courses and life science courses.

1. If semester juniors have taken ME 410, but not ME 420, would BME still require that they take ME 2040?

Transition Plan: Semester juniors will be advised to make sure they take ME 420 in their sophomore year. This should not be an issue for the student, as ME 420 is already a requirement for several BME domain courses.

2. If semester juniors have taken ANAT 220, but not EEOB 232, and vice versa, would BME still require that they take ANAT 2200?

Transition Plan: BME will advise semester juniors early on to take EEOB 232 in Sophomore year, so students have both ANAT 220 and EEOB 232 in quarter system. To accommodate this, students will be directed to take EEOB 232 in the Spring 2011 (quarter), and move STAT 427 to Fall 2012 (taken as STAT 4278).

3. Semester juniors will be strongly advised to take MSE 205 in the Sophomore year as is currently listed in the quarter BINGO sheet, as this is a pre-req for a Fall Junior year Domain course.

**Senior class:** There are no anticipated transition issues for this group of students. Several of the courses taken in the senior year, Capstone Design and Professional Development, have senior status as the only requirement. Other courses, BME advanced courses, Technical Electives, and GEs, all have pre-requisites that the student will have had time to plan ahead in the quarter system.

**14. Assessment Practices**

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

- Assignments, exams and other metrics in the course
- Student evaluations of the course (anonymous, BME-initiated zoomerang survey) and instructor (eSEI).
- 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 Indicate, for an undergraduate degree program or major proposal, whether the program has a plan on file with the Office of Academic Affairs (Yes / No).**

The assessment plan for BME was submitted on the OAA survey form on June 18, 2010.

**Appendix A: BME Major program - Semester Course List**

General Education	Course Number	Hours
Eight (8) courses (2 writing courses)		24
<b>TOTAL</b>		<b>24</b>

Engineering Core	Course Number	Hours
Engineering Survey	ENG 1100	1
Introduction to Engineering I	ENG 1181	2
Introduction to Engineering II	ENG 1183	2
Engineering Calculus I	ENG Calc 1	5
Engineering Calculus II	ENG Calc 2	5
Physics I	Physics 1	5
<b>TOTAL</b>		<b>20</b>

BME Core	Course Number	Hours
Chemistry I	CHEM 1xxx	5
Chemistry II	CHEM 1xxx	5
Physics II	Phys 1132	5
Ord & Par Differential Equations	MATH 2xxx	3
Quant Biology	BIOL 1xxx	3
Probability & Stat	STAT 4278	3
Intro to Organic Chemistry	CHEM 2xxx	3
Statics & Strength of Materials	ME 2040	4
Fluid, Thermo, & Heat	ME 3500	3
Human Anat & Physiology	ANAT 2200	4
Biochemistry	Biochem xxxx	3
Animal Cell & Development	EEOB xxxx	3
Intro to Materials Science & Eng	MSE 2010	3
Intro to BME	BME 2000	3
Numerical Simulations in BME	BME 2700	2
Measurement & Instrumentation	BME 3702	2
Quant Physiology	BME 3703	3
Senior Design I	BME 4901	3
Seniors Design II	BME 4902	3
Professional Development	BME 4900	1
<b>TOTAL</b>		<b>64</b>

BME Core Choices	Course Number	Hours
Domains	BME 4X10	9
BME Advanced Courses	BME 5XXX	6
Technical Electives (6 cr must be ENG)	varies	9
<b>TOTAL</b>		<b>24</b>

<b>BME UNDERGRADUATE MAJOR CURRICULUM</b>	
<b>TOTAL</b>	<b>132</b>

**Appendix A (Continued): BME Major program – BME Core Choices**

<b>BME Domain Courses</b>	<b>Course Number</b>	<b>Hours</b>
Bioimaging	BME 4110	3
Biotransport	BME 4210	3
Biomaterials	BME 4310	3
Biomechanics	BME 4410	3
Molecular, Cell & Tissue Engineering	BME 4510	3
Biomedical Micro/Nanotechnology	BME 4610	3

<b>Advanced BME Courses</b>	<b>Course Number</b>	<b>Hours</b>
Cardiovascular Bioengineering	BME 5001	3
Biomed Microscopic Imaging	BME 5110	3
Biomedical Optics	BME 5120	3
Advanced Biotransport	BME 5210	3
Advanced Biomaterials	BME 5310	3
Biopolymer Structure and Function	BME 5359	3
Mechanobiology	BME 5420	3
Tissue Mechanics	BME 5421	3
Finite Element Analysis Applications in BME	BME 5430	3
Advanced Tissue Engineering	BME 5510	3
Cell Engineering	BME 5520	3
Biomedical Microdevices	BME 5610	3
Medical Devices and Design	BME 5639	3
Biomedical Ultrasound	BME 5186	3
Soft-Tissue Biomaterials	BME 5352	3
Hard-Tissue Biomaterials	BME 5353	3
Cellular Mechanics	BME 5470	3
Biofluid Dynamics of Phys Systems	BME 5475	3
Biomedical Nanotechnology	BME 5661	3
Micro and Nano Fluidics	BME 5663	3
Advanced Biomedical Nanotechnology	BME 5662	3
Cellular Nanotech	BME 5665	3
BioMEMS Microfabrication	BME 5667	3
Biomedical Transducers	BME 5668	3
Advanced Medical Devices and Design	BME 5669	3
Biomedical Instrumentation	BME 5771	3

Appendix B: BME Major program – Current Curriculum Advising (BINGO) Sheet

YEAR	FALL	WINTER	SPRING
1	Math 151 (Calc & Analyc Geom) .....5____ Chem. 121 (Gen Chem.) .....5____ Engr 181 (Intro to Engr I).....3____ Engr 100. (Engr Survey).....1____	Math 152(Calc & Analyc Geom)..... 5____ Chem. 122 (Gen Chem) ..... 5____ Physics 131 (Particles & Motion) ... 5____ Engr 183 (Intro to Engr II)..... 3____	Math 153 (Calc & Analyc Geom)..... 5____ Chem. 123 (Gen Chem) ..... 5____ Physics 132 (Elect and Magt.) ..... 5____ GEC 1 (English 110.) ..... 5____
2	Math 254 (Calc & Analyc Geom) .....5____ Physics 133 (Electrodyn & Quant) ..5____ Biol 113/115 (General Biology/Lab) 5____ ME 410 (Statics).....4____	Math 415 (Ord & Part Diff Equ)..... 4____ GEC 2 (2 <sup>nd</sup> writing) ..... 5____ ME 420 (Intro Strength Mat) ..... 4____ <b>BME 202</b> (Intro BME) ..... 3____ <b>BME 205</b> (Num. Simulations in BME)2____	Stat 427 (Prob and Stat I)..... 3____ <b>Chem 231</b> (Intro Organic Chem) ..... 3____ MSE 205 (Intro Mat Sci) ..... 3____ ME 500 (Fluid, Thermo, Heat) ..... 4____ Anat 220 (Human Anatomy Lab)..... 2____
3	BioChem 511 (Biochemistry) .....5____ ECE 300 (Circuits) .....3____ ECE 309 (Circuits Lab).....1____ EEOB 232 (Intro Physiology) .....5____	EEOB 415 (Animal Cell & Develop) . 4____ Chem. 245 (Organic Chem Lab) .... 2____ GEC 3.....5____ <b>BME 402</b> (Meas & Instrum Lab)..... 2____ BME 4X1 <sup>†</sup> (Domain 1) ..... 4____	GEC 4 ..... 5____ <b>BME 403</b> (Quantitative Physiology) . 4____ BME 4X1 <sup>†</sup> (Domain 2) ..... 4____ BME 4X1 <sup>†</sup> (Domain 3) ..... 4____
4	GEC 5.....5____ <b>BME 501</b> (Design I) .....4____ <b>BME 503</b> (Professional Development)1____ BME 581.1 (Seminar) .....0____ ††BME 6/7/xx 1 or *Prof E 1 ...3____ ††BME 6/7/xx 2 or *Prof E 2 ...3____	GEC 6.....5____ <b>BME 502</b> (Design II) ..... 5____ BME 581.2 (Seminar) ..... 0____ ††BME 6/7/xx 1 or *Prof E 1 ... 3____ ††BME 6/7/xx 2 or *Prof E 2 ... 3____	GEC 7 ..... 5____ BME 581.3 (Seminar) ..... 1____ *Prof E 3..... 3____

Courses printed in **BOLD** above are taught one quarter per year, including all BME courses. Please check On-Line Course Offerings for availability of all courses.

**GENERAL EDUCATION** (35 hrs)

English & Communication Skills (10)  
English 110.xx ( 5 ) \_\_\_\_\_  
2<sup>nd</sup> Writing Course ( 5 ) \_\_\_\_\_  
Writing in core ( ) \_\_\_\_\_  
Students must take 25 hours across Social Sciences, Historical Study, and Arts & Humanities with a minimum of 5 hours and maximum of 10 hours per category.  
Historical Study (5-10)  
\_\_\_\_\_ ( ) \_\_\_\_\_  
\_\_\_\_\_ ( ) \_\_\_\_\_  
Arts & Humanities (5-10)  
\_\_\_\_\_ ( ) \_\_\_\_\_  
\_\_\_\_\_ ( ) \_\_\_\_\_  
Social Sciences (5-10)  
\_\_\_\_\_ ( ) \_\_\_\_\_  
\_\_\_\_\_ ( ) \_\_\_\_\_  
ETHICS (5 Hours)  
(May overlap w/ a GEC category)  
\_\_\_\_\_ ( ) \_\_\_\_\_  
SOCIAL DIVERSITY  
(May overlap w/ a GEC category)  
\_\_\_\_\_ ( ) \_\_\_\_\_

†BME Domain Courses (choose *min of 3*)

**BME 411** (Bioimaging) \_\_\_\_\_  
**BME 421** (Biotransport) \_\_\_\_\_  
**BME 431** (Biomaterials) \_\_\_\_\_  
**BME 441** (Biomechanics) \_\_\_\_\_  
**BME 451** (Molecular, Cell and Tissue Eng) \_\_\_\_\_  
**BME 461** (Biomed micro/nano tech) \_\_\_\_\_  
††BME Advanced Courses (choose *2*) for focus following domain courses  
**BME 6/7/XX 1** \_\_\_\_\_  
**BME 6/7/XX 2** \_\_\_\_\_  
**\*PROFESSIONAL ENGINEERING ELECTIVES** (9 hrs)  
ProfE 1 ( 3 ) \_\_\_\_\_  
ProfE 2 ( 3 ) \_\_\_\_\_  
ProfE 3 ( 3 ) \_\_\_\_\_

Credit hour distribution

General Education .....35  
Mathematics.....27  
Chemistry.....25  
Physics.....15  
Engineering Sciences.....26  
Life Sciences.....16  
BME Courses (Min).....40  
    BME Core Courses .....22  
    BME Domain Courses ...12  
    Advanced BME Courses...6  
Professional Engineering Electives.....9  
Total Engineering credits (min).....75  
TOTAL HOURS .....193  
Acceptance into the Biomedical Engineering major is limited and will depend on the outcome of the application process that includes information about cumulative point-hour ratio (CPHR) upon completion of the following pre-major courses: *Chemistry 121,122,123; Math 151,152, & 153, Physics 131,132, ENGR 181, 183*, essay and interview. Formal admission to BME is required to take **BME 202**. Students are accepted into the major in Autumn quarter with the applications due in Spring



Appendix C: BME Major program – Proposed Curriculum Advising (BINGO) Sheet

YEAR	FALL	SPRING
1	Math 1151 .....5____ Chem 1xxx (Gen Chem.) .....5____ Engr 1181 (Intro to Engr I) .....2____ Engr 1100. (Engr Survey) .....1____ GEC 1 .....3____ TOTAL = 16	Math 1152 ..... 5____ Chem 1xxx (Gen Chem) ..... 5____ Engr 1183 (Intro to Engr II)..... 2____ Physics 1131 ..... 5____ TOTAL =17
2	Math 2xxx (Ord & Part Diff Eq) .....3____ Physics 1132 .....5____ Biol 1xxx (Quant. Biology) .....3____ <b>BME 2000</b> (Intro BME) .....3____ ME 2040 .....4____ TOTAL = 18	Chem 2xxx (Intro Organic Chem) ..... 3____ MSE 2010..... 3____ GEC 2..... 3____ ME 3500 (Fluid, Thermo, Heat) ..... 3____ <b>Anat 2200</b> (Phys/Anat Lab)..... 4____ <b>BME 2700</b> (Num. Simulation in BME) . 2____ TOTAL =18
3	Stat 4278 (Prob and Stat I) .....3____ BioChem 3xxx (Biochemistry) .....3____ EEOB 3xxx (Animal Cell & Develop) 3____ *TechE 1 .....3____ <b>BME 4X10<sup>†</sup></b> (Domain 1) .....3____ TOTAL = 15	<b>BME 3702</b> (Meas & Instrum Lab)..... 2____ <b>BME 3703</b> (Quantitative Physiology) .. 3____ <b>BME 4X10<sup>†</sup></b> (Domain 2) ..... 3____ <b>BME 4X10<sup>†</sup></b> (Domain 3) ..... 3____ GEC 3..... 3____ GEC 4..... 3____ TOTAL = 17
4	<b>BME 4901</b> (Design I) .....3____ <b>BME 4900</b> (Prof Development) .....1____ ††BME 5xxx 1 or *TechE 2 .....3____ ††BME 5xxx 2 or *TechE 3 .....3____ GEC 5.....3____ GEC 6.....3____ TOTAL = 16	<b>BME 4902</b> (Design II) ..... 3____ ††BME 5xxx 1 or * TechE 2..... 3____ ††BME 5xxx 2 or * TechE 3..... 3____ GEC 7.....3____ GEC 8..... 3____ TOTAL = 15

BME courses are printed in BOLD.

GENERAL EDUCATION (24 hrs)

English & Communication Skills (6)  
English 1110.xx ( 3 ) \_\_\_\_\_  
2<sup>nd</sup> Writing Course ( 3 ) \_\_\_\_\_  
Writing in core ( ) \_\_\_\_\_  
 Students must take 18 hours across Social Sciences, Historical Study, and Arts & Humanities with a minimum of 3 hours and maximum of 6 hours per category.  
Historical Study (3-6)  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
Arts & Humanities (3-6)  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
Social Sciences (3-6)  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
ETHICS (3 Hours)  
 (May overlap w/ a GEC category)  
 \_\_\_\_\_ ( ) \_\_\_\_\_  
SOCIAL DIVERSITY  
 (May overlap w/ a GEC category)  
 \_\_\_\_\_ ( ) \_\_\_\_\_

†BME Domain Courses (choose *min of 3*)

BME 4110 (Bioimaging) \_\_\_\_\_  
BME 4210 (Biotransport) \_\_\_\_\_  
BME 4310 (Biomaterials) \_\_\_\_\_  
BME 4410 (Biomechanics) \_\_\_\_\_  
BME 4510 (Molecular, Cell and Tissue Eng) \_\_\_\_\_  
BME 4610 (Biomed micro/nano tech) \_\_\_\_\_  
 ††BME Advanced Courses (choose 2) for focus following domain courses  
BME 5XXX 1 \_\_\_\_\_  
BME 5XXX 2 \_\_\_\_\_  
 \*TECHNICAL ELECTIVES (2 must be ENG)  
TechE 1 \_\_\_\_\_  
TechE 2 \_\_\_\_\_  
TechE 3 \_\_\_\_\_

BME Seminar (Sr. Year-Optional)

BME 4881.01 and 4881.02 ( 1 ) \_\_\_\_\_

Credit hour distribution

General Education.....	24
Mathematics.....	16
Chemistry.....	16
Physics.....	10
Engineering Sciences.....	15
Life Sciences.....	10
BME Courses.....	32
BME Core Courses .....	17
BME Domain Courses ...	9
BME Advanced Courses...6	
Technical Electives.....	9
Total Engineering credits (min 48). ...	53-56
TOTAL HOURS .....	132

Acceptance into the Biomedical Engineering major is limited and will depend on the outcome of the application process that includes information about cumulative point-hour ratio (CPHR) upon completion of the following pre-major courses: *Chemistry 1,2; Math 1,2; Physics 1; ENGR 1181/1183*; essay. Formal admission to BME is required to take BME 2000. Students are accepted into the major in Spring

Appendix D: Biomedical Engineering Curriculum Map: Courses to Program Outcomes (Proposed)

Course Number	a	b	c	d	e	f	g	h	i	j	k	l	m
MATSCEN 2010	***	**	**		**					*	**		
MECHENG 2040	***		*		***		*				*		
MECHENG 3500	***				***						***		
BIOMEDE 2000	***		*		**	*	*				*	**	*
BIOMEDE 2700	**				*						***	**	
BIOMEDE 3000	***		*		**	*	*				*	**	*
BIOMEDE 3702		**		**									**
BIOMEDE 3703	***		**		***						***	**	*
BIOMEDE 4110	***	*		*	*		*		*			**	*
BIOMEDE 4210	***	*			***		*		*		**	***	**
BIOMEDE 4310	**	**	**	*	*		*		*	*	*	**	*
BIOMEDE 4410	***		*	*	**		*		*	**	**	***	**
BIOMEDE 4510	***	**	*	*	**		*		*		**	***	**
BIOMEDE 4610	**	*					*	*	**	*	*	**	
BIOMEDE 4881								*		**			
BIOMEDE 4882								**		***			
BIOMEDE 4900						**	*					*	
BIOMEDE 4901			***	***	*		*	*				***	
BIOMEDE 4902		**	***	*				*			*	***	
BIOMEDE 5000	*	*			*		*		*				
BIOMEDE 5001	**		*		*		*	*	*	*	*	***	
BIOMEDE 5110	**	*	*				*				*	*	*
BIOMEDE 5120	***		*		**	*		*			*	*	
BIOMEDE 5186	***				***							**	
BIOMEDE 5210	***				***		*				**	***	
BIOMEDE 5310	*				**			**	**	**			
BIOMEDE 5320	**	**			*					*	***		
BIOMEDE 5352	**	***					**			**			
BIOMEDE 5353		**				**			**	**			
BIOMEDE 5359		**						**	**	***			
BIOMEDE 5420	*				*		*	*	*	*	**	***	

Course Number	a	b	c	d	e	f	g	h	i	j	k	l	m
BIOMEDE 5421												***	**
BIOMEDE 5430	**		*		**				*	*	**	***	
BIOMEDE 5470	***						*				**	***	
BIOMEDE 5475	***						*				**	***	
BIOMEDE 5510	**		*		*		*	*	*	*	*	***	
BIOMEDE 5520	**				*		*	**	**	**		***	
BIOMEDE 5610	***		**		**		*			*		*	**
BIOMEDE 5639			***	*		**		*		*	*		
BIOMEDE 5661			*				**		***	***		*	
BIOMEDE 5662			*				**		***	***		*	
BIOMEDE 5663	***	*	*	*	**						*		
BIOMEDE 5667	***	*	*		**			*	*	*			
BIOMEDE 5668	***	**	***	**	***		*	*		*	*		
BIOMEDE 5669			***	*		*	*				***		
BIOMEDE 5771		**		**									**
BIOMEDE 6115													
BIOMEDE 6479	*		*	*	**		*	*	*	*	**	***	
BIOMEDE 6934						*			*		*		
BIOMEDE 6983						***		***		**			

Appendix E: Compliance with ABET requirements during transition.

## Continuous Fulfillment of ABET Requirements Throughout Semester Conversion

(Data based on current Quarter-BINGO sheet and proposed Semester-BINGO sheet)

Quarter system (year)	Quarter credit hours		Semester System (year)	Semester credit hours		4 year Converted Semester credit hours		ABET fulfilled?
	Math/Science	Engineering		Math/Science	Engineering	Math/Science	Engineering	
1 Fr, Soph, Jr	83	49	Sr	0	19	55.33	51.67	Yes
2 Fr, Soph	67	27	Jr, Sr	9	33	53.67	51.00	Yes
3 Fr	40	7	Soph, Jr, Sr	27	48	53.67	52.67	Yes

Note: TechE1 (which can be ENG or non-ENG course) was not included in any category. Still, all minimums are met.

Note: BME 581 (which is still under discussion) was not included in any category. Still, all minimums are met.

ABET requirements:

1. one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline

**Qtr: 1 yr = 48 cr hr; Sem: 1 yr = 32 cr hr**

2. one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.

**Qtr: 1.5 yr = 64 cr hr; Sem: 1.5 yr = 48 cr hr**