TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: Changes in Undergraduate Program Degree Requirements for the Bachelor of
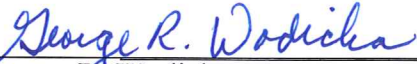   Science in Biomedical Engineering

The Faculty of the School of Biomedical Engineering has approved the following changes to the
curriculum for the B.S. degree in Biomedical Engineering effective for students entering the
Weldon School for the Fall Semester 2017. This action is now submitted to the Engineering
Faculty with a recommendation for approval. A revised Suggested Plan of Study is attached.
New courses and changes in required courses are shown in bold.

The proposed changes are as follows:

A. **First Year of the POS has been changed to match the FYE plan of study.** – This
   brings the BME suggested plan of study in line with College of Engineering expectations
   regarding the uniformity of the first year experience across the college.
B. **Require ABE 24200 Thermodynamics in Biological Systems II in place of ME 20000
   Thermodynamics I and as a prerequisite of BME 30400** – This newly designed course
   will deliver targeted biological systems-related content, application, and examples.
C. **Modify BME 20400 Biomechanics of Hard & Soft Tissue to include Biomaterials
   content, removing the need for MSE 23000 Structure & Properties of Materials;
   Move PHYS 24100 Electricity and Optics into the 4th semester** – This will free space
   in an already credit-heavy Sophomore year and reflects changes made to the course
   content of BME 20400 to include some basic materials content from MSE 23000 and
   additional biomaterials content not found in MSE 23000. The freeing of 3 credit hours
   also allows for more flexibility in the curriculum, and moving PHYS 24100 into the
   Spring semester makes room for CS 15900 Programming Applications for Engineers to
   fit into the curriculum in the Fall of Sophomore year.
D. **Replace IE 33000 Probability and Stats in Engr. II with STAT 51100 Statistical
   Methods, and moved to the 5th semester** – STAT 51100 includes Statistics foundation
   material not completely covered in IE 33000 that is necessary for the senior design
   projects course. Moving it to the 5th semester in the POS allows for students to begin to
   utilize the statistical analyses in BME 39000, the preparatory course for senior design
   projects.
E. **Remove BME 48800 Preliminary Project Design and increase BME 48900 Senior
   Design Project Lab from 2 to 3 credit hours and increase BME 39000 Professional
   Development & Design in BME from 1 to 2 credit hours** – By incorporating the
   content of BME 48800 into BME 39000 and BME 48900 we spread the workload and
   extend the capstone design process over two semesters (Spring and Fall), remove
   redundancy, and streamline the Fall semester capstone design courses to match the
   format of other BME lecture and lab course pairings. This increase in credits in the
   design sequence requires reduction of unrestricted electives from 5 to 3 credits.

F. **Inclusion of Science Selective in core requirements** – This allows either CHM 11600 General Chemistry or CS 15900 Programming Applications for Engineers to be used as the science selective taken during FYE, or planned as a core course for the BME POS.

G. **Modification of the General Education Program** – These policies have been changed to reflect the current University Core Curriculum Foundational Learning Outcomes and additional programmatic requirements to meet ABET accreditation standards.

H. **Updates to the list of courses included in the BME GPA** – These changes reflect the above changes regarding the removal of BME 48800 and the inclusion of ABE 24200. MSE 23000 and ME 20000 will remain in the calculation to allow for the matriculation of current students who already have taken these courses.

Reason: The proposed program changes to degree requirements for the Bachelor of Science in Biomedical Engineering are to update the minimum requirements for this program, clarify the plan of study, and increase the flexibility the curriculum to allow students to take less traditional academic paths without hindrance or delay. The proposed program changes to degree requirements provide students with 1. The necessary basic science and engineering knowledge and skills, 2. Integration of University and College of Engineering programmatic requirements, 3. Infusion of the principles of other related engineering disciplines within BME-specific courses, and 4. Increased flexibility within the curriculum. The proposed changes to our degree program will continue to satisfy ABET requirements for Biomedical Engineering. The revised suggested plan of study provides students with a more flexible, integrated and efficient pathway of course selection that still allows for diversification before the final year depending on student interest.

George R. Wodicka
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering

[Approved] Suggested Plan of Study - Effective Fall 2011

Credit hours required for graduation: 130

Freshman Year

First Semester	*Second Semester*
(4) MA 16500 Analytical Geom. & Calc. I	(4) MA 16600 Analytical Geom & Calc. II
(4) CHM 11500 General Chemistry	(4) CHM 11600 General Chemistry
(4) PHYS 17200 Modern Mechanics	(3) CS 15900 Programming Apps for ENGRS~
(2) ENGR 13100 Transforming Ideas to Innov I	(2) ENGR 13200 Transforming Ideas to Innov II
(3/4) ENGL 10800/10600 Accelerated / Composition	(3) General Education Elective
17/18	16

Sophomore Year

Third Semester	*Fourth Semester*
(3) BME 20100 Biomolecules: Strct, Funct & Engr Apl	(3) BME 20400 Biomechanics Hard/Soft Tissue
(3) BIOL 23000 Biology of the Living Cell	(3) MSE 23000 Structure & Properties Materials
(1) BME 20500 Biomolec & Cellular Syst Lab	(1) BME 20600 Biomechanics & Biomaterial lab
(1) BME 29000 Frontiers in BME	(3) BME 25600 Physiol Modeling Human Health
(4) MA 26100 Multivariate Calculus	(3) MA 26600 Ordinary Differential Equations
(3) ME 27000 Basic Mechanics I	(3) ME 20000 Thermodynamics I
(3) PHYS 24100 Electricity and Optics	16
18	

Junior Year

Fifth Semester	*Sixth Semester*
(3) BME 30100 Bioelectricity	(2) BME 30600 Biotransport Laboratory
(3) BME 30500 Bioinstrumentation Circuit & Meas Princip	(1) BME 39000 Profes Devlp & Design in BME
(3) BME 30400 Biomedical Transport Fundamentals	(3) ECE 30100 Signals and Systems
(3) BME Technical Elective	(3) IE 33000 Probability and Stats in Engr. II
(3) Gen. Ed. or Ethics Elective (PHIL 28000)	(3) BME Technical Elective
15	(3) Gen. Ed. or Ethics Elective (PHIL 27000)
	15

Senior Year

Seventh Semester	*Eighth Semester*
(1) BME 49000 Professional Elements of Design Lab	(2) BME 48900Senior Design Project Lab*
(1) BME 48800 Preliminary Project Design	(*can be taken in the Fall)
(3) BME Technical Elective#	(3) BME Technical Elective
(3) BME Technical Elective	(3) Life Science Elective
(3) Life Science Elective	(3) General Education Elective
(3) General Education Elective	(3) General Education Elective
(2) Unrestricted Elective or BME 48900*	(3) Unrestricted Elective
16 (*Senior Project Design Lab, can be taken Spring)	17

~CS 15900 is required before junior year and recommended for the first year.
Taken from the list of Quantitative Breadth courses.

[Current] B.S. BME Degree Program Requirements

Minimum Degree Requirements for Bachelor of Science in Biomedical Engineering (BSBME)
Credit Hours Required for Graduation: 130

All required First-Year Engineering courses * must be completed with a C⁻ or above for entry into the BME undergraduate program = 30 credits
*No more than 8 credit hours of freshman calculus can be applied towards the BME degree.

Core Biomedical Engineering (BME) Courses (24 credit hours);
BME 20100, 20400, 20500, 20600, 25600, 29000, 30100, 30400, 30500, 30600, 39000

BME Breadth Requirement (43 credit hours):

Core Life Sciences Requirement: BIOL 23000 and two (2) additional Life Science courses† = 9 credits
Core Engineering Requirement: ECE 30100; **IE** 33000(or STAT 51100), **ME** 20000, 27000; and **MSE** 23000 = 15 credits
BME Technical Engineering Electives: Five (5) additional BME or other Engineering courses.†# At most 6 credits at the 300 level; must include at least one 3-credit 400-level BME course; must include at least one 3-credit course chosen from the Quantitative breadth list†. = 15 credits.
Senior Design Capstone Requirements: BME 48800, 48900, 49000 = 4 credits

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Advanced Physics and Math (10 credit hours):
PHYS 24100, **MA** 26100 and (**MA** 26600 or **MA** 26200)

General Education Electives (18 credit hours): Course selections must meet the General Education Program requirements. Refer to "*General Education Program.*"
Includes an ethics elective to be chosen from the Ethics list†.

Unrestricted Electives (5 credit hours): Additional coursework to fulfill the total number of credits required for graduation.

GPA Requirement: A minimum Graduation Index of at least 2.0 is required to qualify for graduation with a BSBME. A minimum BME Major GPA** of at least 2.0 is also required to qualify for graduation with a BSBME.
**Courses included in BME Major GPA: BME 20100, BME 20400, BME 20500, BME 20600, BME 25600, BME 29000, BME 30100, BME 30400, BME 30500, BME 30600, BME 39000, BME 48800, BME 48900, BME 49000, ME 20000, ME 27000, MSE 23000, ECE 30100, & IE 33000 (or STAT 51100).

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† Selected from a list of courses approved by the Biomedical Engineering faculty and maintained by the undergraduate advising office.
# must complete a 400-level BME elective with at least a B- before student can take a BME 500-level course as a technical elective.

[Revised] Suggested Plan of Study - Effective Fall 2017 ==Changes are highlighted==

Credit hours required for graduation: 130

First Year

First Semester	Second Semester
(4) MA 16500 Analytical Geom. & Calc. I	(4) MA 16600 Analytical Geom & Calc. II
(4) CHM 11500 General Chemistry	==(4) Science Selective~==
(2) ENGR 13100 Transforming Ideas to Innov I	==(4) PHYS 17200 Modern Mechanics==
==(3) Oral or Written Communication==	(2) ENGR 13200 Transforming Ideas to Innov II
==13==	==(3) Oral or Written Communication==
	==17==

Second Year

Third Semester	Fourth Semester
(3) BME 20100 Biomol: Strct, Funct & Engr Apl	(3) BME 20400 Biomechanics Hard/Soft Tissue
(1) BME 20500 Biomolec & Cellular Syst Lab	(1) BME 20600 Biomechanics & Biomaterial lab
(1) BME 29000 Frontiers in BME	(3) BME 25600 Physiol. Modeling of Human Health
(3) BIOL 23000 Biology of the Living Cell	==(3) PHYS 24100 Electricity and Optics==
(4) MA 26100 Multivariate Calculus	(4) MA 26200+ Linear Algebra & Ordinary Diff. Eq.
(3) ME 27000 Basic Mechanics I	==(3) MSE 23000 Structure & Properties Materials==
==(3) Science Selective~==	==(3) ME 20000 Thermodynamics I==
18	==(3) ABE 24200^ Thermodynamics in Bio Sys II==
	17

Third Year

Fifth Semester	Sixth Semester
(3) BME 30100 Bioelectricity	(2) BME 30600 Biotransport Laboratory
(3) BME 30400 Biomedical Transport Fundamentals	==(2) BME 39000 Profes Devlp & Design in BME==
(3) BME 30500 Bioinstr Circuit & Meas Princip	(3) ECE 30100 Signals and Systems
==(3) STAT 51100 Statistical Methods==	==(3) IE 33000 Probability and Stats in Engr. II==
(3) Gen. Ed. or Ethics/Policy Elective	(3) BME Technical Elective
15	(3) BME Technical Elective (Quantitative Breadth++)
	(3) Gen. Ed. or Ethics/Policy Elective
	16

Fourth Year

Seventh Semester	Eighth Semster
==(1) BME 48800 Preliminary Project Design==	(3) BME Technical Elective
==(3) BME 48900 Senior Design Project Lab==	(3) BME Technical Elective
(1) BME 49000 Professional Elements of Design	(3) Life Science Elective
(3) BME Technical Elective	(3) General Education Elective
(3) Life Science Elective	(3) General Education Elective
(3) General Education Elective	==(3) Unrestricted Elective==
(3) General Education Elective	18
16	

Note: ENGR 141/142 fulfills ENGR 131/132 and CS 159; ENGR 161/162 fulfils ENGR 131/132 and PHYS 172

==~ Both CS 15900 and CHM 11600 are required for the BME program, however CHM 11600 is preferred to be taken in the first year.==
\+ MA 26500: Linear Algebra *AND* MA 26600: Ordinary Differential Equations combined fulfill the MA 26200 requirement.
\++ Taken from the list of Quantitative Breadth courses.
==^ ABE 24200 is in development, and will be offered in Spring 2017 as ABE 20200==

[Revised] <u>B.S. Biomedical Engineering Degree Requirements</u>   *Changes are highlighted*
Credit Hours Required for Graduation: 130

All required First Year Engineering courses* must be completed with a C- or above for entry into the BME undergraduate program = 30 credits
* No more than 8 credit hours of first-year calculus can be applied toward the BME degree.

Science Selectives (3 credit hours#): **CHM** 11600 and **CS** 15900

Core Biomedical Engineering (BME) Courses (25 credit hours);
BME 20100, 20400, 20500, 20600, 25600, 29000, 30100, 30400, 30500, 30600, 39000

BME Breadth Requirement (28 credit hours):
Core Engineering: ABE 24200, **ECE** 30100, ~~IE 33000 (or STAT 51100),~~ **MSE 23000,** and **ME** ~~20000,~~ 27000 = 9 credits
BME Technical Engineering Electives: Five (5) additional BME or other Engineering courses.† At most 6 credits at the 300 level; must include at least one 3-credit 400-level BME course; must include at least one 3-credit course chosen from the Quantitative breadth list†. = 15 credits.
Senior Design Capstone Requirements: BME ~~48800,~~ 48900 (3), 49000 (1) = 4 credits

Advanced Science and Math, (23 credit hours):
BIOL 23000, **PHYS** 24100, **MA** 26100 and **MA** 26200 or (**MA** 26500 <u>and</u> **MA** 26600), **STAT** 51100, and two (2) additional Life Science courses†

General Education Program (18 credits**):
• *University Core Curriculum Foundational Learning Outcomes:*
   - Students must select from the university's list of courses to satisfy the following UCC FLOs: written communication, oral communication, information literacy, human cultures: humanities, human cultures: behavioral/social sciences, and science, technology and society.
   - Students must earn a C- or better to receive credit towards the Foundational Learning Outcome
• *Programmatic Requirements:*
   - Sufficient credit hours to meet the minimum 18 credit hour requirement†
   - At least 12 credit hours must be in the College of Liberal Arts, Krannert School of Management, and/or Honors College Courses (FYE general education included)†
   - At least 6 credit hours must be non-introductory (courses at the 30000-level or above, or with a required prerequisite in the same department)
   - At least one 3 credit ethics, medical or healthcare policy elective to be chosen from our Ethics and Policy Healthcare (EPH) List†
** In addition to the 6 credits of Written Communication and Oral Communication foundational learning outcomes from the University Core Curriculum taken in First Year Engineering.

Unrestricted Electives (3 credit hours): Unrestricted elective credits intended for curricular flexibility counted towards the total number of credits required for graduation.

GPA Requirement: A minimum Graduation Index of at least 2.0 is required for graduation with a BSBME. A minimum BME Major GPA*** of at least 2.0 is also required for graduation with a BSBME.
***Courses included in BME Major GPA: BME 20100, BME 20400, BME 20500, BME 20600, BME 25600, BME 29000, BME 30100, BME 30400, BME 30500, BME 30600, BME 39000, ~~BME 48800,~~ BME 48900, BME 49000, ABE 24200 (or ABE 20200, or ME 20000), ME 27000, ECE 30100, ~~IE 33000 (or~~ STAT 51100), (BME 48800, MSE 23000 if applicable)

\# 3-4 science selective credits will count toward the 30 credits of First Year Engineering requirements.
† Selected from a list of courses approved by the Biomedical Engineering Undergraduate Curriculum Committee and maintained by the undergraduate advising office. Must complete a 40000-level BME elective with at least a B- or above before student can take a BME 50000-level course as a technical elective.