

UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, November 19 – 1:30-3:00pm
Lurie Engineering Center, GM Conference Hall

Attending: Dale Karr; Susan Montgomery; Won Sik Yang; Kevin Pipe; Yavuz Bozer; Xeuding Wang; Gretchen Keppel-Aleks; Ed Durfee; Leung Tsang; Emmanuelle Marquis; Fred Terry; Christina Rice; Christian Lastoskie; Fei Wen; guests: Rachael Schmedlen; supporting staff: Elizabeth Dodge; Matt Faunce

Call to Order: 1:39

Adjourned: 3:01

AGENDA

1. 11.5.19 Meeting Minutes Approval: APPROVED
2. BME Curriculum Change [Rachael Schmedlen to present]: APPROVED; Rachael outlines students growing interest in computation; student concentrations too similar; organic chemistry not universal; and faculty flexibility for teaching courses, among others as reasons for change. Want to remove Organic Chemistry and Biochem from core BME curriculum. Make Bio 241 statistics/computation based. Add more lab requirements to courses. Eliminate concentrations, replace with “Depth Requirements.” Susan brings up replacing “Advanced STEM” classes with another name, 200 level courses are not advanced. Kevin mentions why they are taking out chemistry, BME is trying to balance mechanics side, and bio/chem side. Conversation about potentially add MSE 250 to curriculum.
3. Minimum Grade for Intellectual Breadth in Degree Audit [Betsy Dodge to present]: Committee suggests that there should be a uniform minimum grade for IB classes in the college. Committee voted to recommend to departments that a D- should be a uniform policy. Next steps will be reaching out to program chairs in departments that do not have a D-.
4. CARF Form Modification Summary [Betsy Dodge to present]: Added a new line for the CC member to sign the CARF, as well as adding a printed name line for clarification. When a CARF does not have a signature, have a little more push back as to why it is not signed.
5. Curriculum Committee Member Guide [informational item]: Dale brings up to make it clearer that when a member cannot make it, a substitute can come and represent the department.

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
18	BIOMEDE	211	MOD		FA 2020	C-	X		
21	BIOMEDE	221	MOD	change to enforced prerequisites	FA 2020	C-	X		

24	BIOMEDE	231	MOD		FA 2020	C-	X		
27	BIOMEDE	241	MOD	change to enforced prerequisites	FA 2020	C-	X	Fred suggests adding “or ENGR 151 or EECS 280” to enforced prereqs. Kevin suggests adding “for Biomedical Engineering in title.	
30	BIOMEDE	321	MOD	change to enforced prerequisites	FA 2020	C-	X		
33	BIOMEDE	350	MOD	change to enforced prerequisites	FA 2020	C-	X	Add honors equivalents for Math 216	
36	BIOMEDE	418	MOD	change to enforced prerequisites	FA 2020	C-	X		
39	BIOMEDE	419	MOD	change to enforced prerequisites	FA 2020	C-	X		
42	BIOMEDE	451	MOD	change to enforced prerequisites	FA 2020	C-	X		
45	BIOMEDE	458	MOD	change to enforced prerequisites	FA 2020	C-	X		
53	MATSCIE	480	MOD		FA 2020		X		
56	MATSCIE	489	MOD		FA 2020		X		

59	CEE	431	DELETE		WN 2020		X		
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UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, November 19 – 1:30-3:00pm
Lurie Engineering Center, GM Conference Hall

AGENDA

1. 11.5.19 Meeting Minutes Approval (pg 3)
2. BME Curriculum Change [*Rachel Schmedlen to present*] (pg 5)
3. Minimum Grade for Intellectual Breadth in Degree Audit [*Betsy Dodge to present*] (pg 48)
4. CARF Form Modification Summary [*Betsy Dodge to present*] (pg 49)
5. Curriculum Committee Member Guide [*informational item*] (pg 50)

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
18	BIOMEDE	211	MOD		FA 2020	C-			
21	BIOMEDE	221	MOD	change to enforced prerequisites	FA 2020	C-			
24	BIOMEDE	231	MOD		FA 2020	C-			
27	BIOMEDE	241	MOD	change to enforced prerequisites	FA 2020	C-			
30	BIOMEDE	321	MOD	change to enforced prerequisites	FA 2020	C-			
33	BIOMEDE	350	MOD	change to enforced prerequisites	FA 2020	C-			

36	BIOMEDE	418	MOD	change to enforced prerequisites	FA 2020	C-			
39	BIOMEDE	419	MOD	change to enforced prerequisites	FA 2020	C-			
42	BIOMEDE	451	MOD	change to enforced prerequisites	FA 2020	C-			
45	BIOMEDE	458	MOD	change to enforced prerequisites	FA 2020	C-			
53	MATSCIE	480	MOD		FA 2020				
56	MATSCIE	489	MOD		FA 2020				
59	CEE	431	DELETE		WN 2020				

UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
November 5, 2019 – 1:30-3:00pm
Lurie Engineering Center, GM Conference Hall

Attending: Dale Karr; Susan Montgomery; Won Sik Yang; Kevin Pipe; Xeuding Wang; Glen Daigger; Jwo Pan; Ed Durfee; Luis Bernal; Leung Tsang; Emmanuelle Marquis; Aaron Ridley; Fred Terry; Christina Rice; guests: Paula Lantz; Susan Guindi; Joanna Millunchick; supporting staff: Elizabeth Dodge; Joshua Wirgau

Call to Order: 1:35

Adjourned: 2:58

AGENDA

1. Approval of 10.22.2019 Meeting Minutes: APPROVED
2. Proposal of Master of Engineering in Electrical and Computer Engineering [Leung Tsang presented]: new Master's degree with two concentrations (Data Science, Machine Learning and Autonomous Systems); approved for 26 credits, effective Fall 2020; considerable discussion regarding whether or not the CoE should continue to approve Master's programs with less than 30 credits.
3. Creation of Minor in Public Policy [Paula Lantz and Susan Guindi presented]: APPROVED; Paula and Susan outlined LSA's restriction of only 80 students in their BA in Public Policy program and felt the minor, with only 16 credits, gave students a different option; effective Fall 2020; noted that with CoE's intellectual breadth requirements, some students may only need an extra course or two to fulfill the requirements.
4. CoE Minors Policy [Betsy Dodge presented]: Committee elected to remove rule "B" from Minors Policy, with corresponding language to be removed from the Bulletin; may be brought up at UPAGE; to be added as a future meeting informational item.
5. Curriculum Committee Member Guide [informational item]: moved to next meeting.

CARF SUMMARIES


PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
22	EECS	605	NEW		TBD		X	Conditionally approved pending processing of CARF in the CARF system with CoE CARF form; addition of Effective Term; addition of signatures.	
47	CLIMATE	172	MOD		WT 2019		X	Conditionally approved pending addition of cross-listed signatures.	

50	SPACE	471	NEW		WT 2020		X	Conditionally approved pending change of “principals” to “principles” in course description; reduce course description length.	
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MEMORANDUM

Date: November 2, 2019

To: CoE Curriculum Committee

From: Rachael Schmedlen, Associate Chair of Undergraduate Education 

Subject: Biomedical Engineering Curriculum Revision Proposal for Fall 2020

Dear CoE Curriculum Committee Members,

On behalf of the faculty of the Biomedical Engineering Department, I present to you a proposal for revisions to our undergraduate curriculum and request your approval for implementation in Fall 2020. In particular, we seek to make changes to our biomedical engineering (BME) core curriculum, removing organic chemistry and biochemistry as requirements, revising BME 241 to include computation with biomedical applications, adding 3-4 lab modules to the existing BME 211, 221, and 231 courses, and increasing the number of credits of our BME 350: Intro to Biomedical Design from 3 to 4.

Additionally, we propose to increase flexibility within the curriculum by eliminating our three concentrations – Biochemical, Biomechanical, and Bioelectrical – and replacing them with Depth Requirements that include “Engineering Expertise” (300-level+ engineering courses), “Advanced Science, Technology, Engineering and/or Math” and an “Experiential Elective(s)”. To help students select courses that satisfy the Depth Requirements and prepare them for their careers, we have created a number of non-compulsory “tracks”, specific to a variety of areas of biomedical engineering, which students may use for guidance. Students may choose to follow one of these tracks or customize their own track specific to their interests and goals. With these changes, we propose increasing the number of credits students use to obtain depth in BME, currently provided by the 14 credits required for the concentration, to 21 credits for the new “Depth Requirement”. This will also reduce the number of general electives required by the program from 11 to 9 credits.

This proposal will outline the current BME curriculum, the proposed new curriculum, the rationale behind these changes, and the transition plans for students continuing with the old curriculum.

I. Rationale for Curriculum Change

1. The BME curriculum has not undergone a substantial overhaul since the creation of the undergraduate program in the late 1990s. As the department has grown, new courses have been added over the years, but the department has not conducted a holistic curriculum review. As BME is a broad and rapidly developing field, an opportunity exists to revise course requirements to reflect the current and future trends in the field.
2. Our constituents have expressed a desire to revise aspects of the curriculum.
 - a. **Through town halls and senior exit surveys, BME students have requested more options for computation content with BME applications.** Currently, ~30% of our students pursue a CS minor or dual major. With the rise of big data in many

biomedical fields, electronic medical records, and security of medical devices, there is a need to provide our students with the basic skills and knowledge to tackle these challenges.

- b. **Some BME faculty, particularly those in biomechanics and bioelectrics, do not believe that organic chemistry and biochemistry knowledge are as essential for success compared to advanced math or engineering courses.** However, BME faculty in tissue engineering and systems biology strongly feel that biochemistry is foundational to their fields. Thus, our faculty would like to incorporate more flexibility into the curriculum so that students may have the option to choose between life sciences, math, or additional engineering courses. Current BME concentrations are rather rigid and two of them (biochemical and biomechanical) have a great deal of overlap, which makes it difficult for students to distinguish themselves within the concentrations. In addition, having biology, organic chemistry, and biochemistry as requirements often results in students delaying enrollment in the 200-level BME core courses until their junior year.
 - c. **Increasingly, industry desires students that not only demonstrate fundamental engineering knowledge, but also multiple design (and problem solving) experiences, as well as project management and general business knowledge (e.g. regulatory, manufacturing).** These skills have been identified by our External Advisory Board and results from a national survey of industrial partners at the BME Education Summit last spring. Again, creating more flexibility in the curriculum would allow students to elect courses in entrepreneurship, business, and other departments to help them acquire these skills, better preparing them for industry.
3. In line with our industry constituents' feedback and ongoing efforts within the CoE, we would also like to expand the experiential learning opportunities within BME. Students consistently rate our lab and design courses as the ones in which they learned the most / best prepared them for their careers and request having additional hands-on courses. These courses often teach practical skills students can leverage to obtain internships and co-ops.

II. Current BME Curriculum

Year 2 – In addition to their math, physics and/or chemistry, and intellectual breadth courses, BME students take Biology (Bio 172), Biomechanics (BME 231) and Principles of Engineering Materials (MSE 250).

Year 3 – Students complete their foundational knowledge in the three broad areas of BME (i.e. biochemical, biomechanical, and bioelectrical) and begin to take their concentration courses. Courses in Circuits and Systems (BME 211) and Biophysical Chemistry and Thermodynamics (BME 221), along with BME 231, provide the background to prepare students for the concentration courses that follow. A lab course (BME 241) teaches students statistical analysis and offers them the opportunity to apply the basic circuit concepts, mechanics of materials, and cell assays learned in the other 200-level courses. The Intro to Design course (BME 350) exposes students to basic CAD and FEA simulation software as well the design process, setting them up for their capstone design course in their fourth year. Lastly, students take a Quantitative Cell

Biology course (BME 418), which allows them to approach the life sciences with a more problem-based, quantitative mindset.

Year 4 – In their final year, students enroll in Quantitative Physiology (BME 419), Biomedical Instrumentation Lab (BME 458), the capstone design course (BME 450 or 451/2), and complete their concentration course requirements. The BME 458 lab builds upon the BME 241 circuits modules and offers a mini design project at the end of the course. Students have the option of electing either the one-semester capstone design course (BME 450) or, for those with an interest in the medical device industry, the year-long design course (BME 451/2). Students may choose between three concentrations – Biochemical, Biomechanical, or Bioelectrical – and must take 14 credits within the concentration, which is intended to provide depth. In general, each concentration has two required courses, a short list of courses in which students must select at least one course, and a longer list of electives to finish the concentration.

III. Proposed New BME Curriculum

Based on the current curriculum concerns outlined above, we propose the following changes:

1. **Remove the first term of organic chemistry and lab (Chem 210/211) and biochemistry (MCDB 310, BiolChem 415, or Chem 351) courses as required courses.** Students will only be required to complete general chemistry and lab (Chem 125/126/130). If they place out of general chemistry, they may elect Chem 210/211 to satisfy the chemistry requirement.
2. **Modify BME 241 (Biomedical Laboratory) to focus on statistics and add new content in computation, data analysis and visualization.** By removing existing lab modules, the course will concentrate on statistics concepts, something students do not feel is covered in enough depth. Lab sessions will allow students to apply statistics concepts to real biomedical data sets while learning fundamental programming, data analysis and visualization skills. This course will serve as a foundational course in biocomputation for all BME students, but especially for those interested in biocomputation, systems biology, or bioinformatics.
3. **Incorporate a few lab modules into the existing BME 211 (Circuits and Systems), BME 221 (Biophysical Chemistry and Thermodynamics), and BME 231 (Biomechanics) courses.** Currently, BME 241 labs cover content from these courses, but it is disconnected from the concepts because students often take BME 241 in a subsequent semester. By integrating labs into BME 211, 221, and 231, students will more readily connect hands-on applications to course content. Each course will incorporate 3-4 modules and adjust the course content and assignments to maintain a workload consistent with 4 credit hours.
4. **Eliminate current concentrations and implement “Depth Requirements” instead, increasing the number of credit hours required for technical depth from 14 to 21 and expanding flexibility.** We propose to do away with the three existing concentrations (Biochemical, Biomechanical, and Bioelectrical) and replace them with “Depth Requirements”. To complete the “Depth Requirements”, students must satisfy requirements in “Engineering Expertise” (12 cr.), “Advanced Science, Technology, Engineering and/or Math” (6 cr.), and an “Experiential Elective(s)” (3 cr.), which will fulfill ABET and CoE upper level elective requirements (45 engineering credits, 30 credits of upper-level engineering, respectively). The “Experiential Elective” will ensure that every BME student

has at least one additional hands-on experience that aligns with their interests and career goals. For guidance, we have created possible tracks that fulfill the “Depth Requirements” to provide students with a collection of course options specific to various pathways within BME. These tracks will be optional and will not appear on transcripts or diplomas, so students can choose to follow one of the tracks, pick courses from a couple of tracks, or customize their schedules depending on their needs.

5. **Increase the number of credit hours from 3 to 4 for BME 350 (Intro to Biomedical engineering Design) and reduce the number of general electives from 11 to 9 credit hours.** This will allow more flexibility and depth as well as emphasize the importance of design in our curriculum. Increasing the credits within BME 350 will allow more focus on software tools, such as CAD and FEA simulation, which student feel are needed for capstone design and industry.
6. **Remove biochemistry as a prerequisite for BME 418 (Quantitative Cell Biology), BME 419 (Quantitative Physiology) and BME 321 (Bioreaction Engineering and Design) as well as organic chemistry as a prerequisite for BME 221.** All of these courses currently cover the basic principles of organic chemistry and biochemistry necessary to master BME principles taught in these courses. Therefore, removing these prerequisites should not affect content or student performance. BME 221 covers these basic concepts and will be the new prerequisite for BME 321, 418, and 419.
7. **Remove BME 241 as a prerequisite for BME 458.** With circuits labs removed from BME 241 under the new curriculum, the content no longer directly prepares students for BME 458.
8. **Add BME 350 as a prerequisite for BME 451.** The software tools learned in BME 350 are required for design work in the BME 451 capstone design course.
9. **Remove Bio 173 as a requirement for students with AP Biology credit.** Bio 173 was required for students to enroll in biochemistry. By eliminating biochemistry as a core BME requirement, Bio 173 will no longer be needed to complete the BME degree requirements. Students that elect to take biochemistry as part of the Depth Requirements will still need to take Bio 173 if they have AP Biology credit.

IV. Transition Plan

We propose to implement these curricular changes effective Fall 2020. Students who declare BME in Fall of 2020 must satisfy the new curriculum requirements, while students declared prior to Fall 2020 will remain subject to the current curriculum. To ensure that both groups of students can complete their requirements, we have developed the following transition plan:

1. **No transition plan is necessary to account for the removal of organic chemistry, biochemistry.** Courses that currently have organic chemistry and/or biochemistry as prerequisites will supplement their content with the relevant concepts in these areas as needed, but most of these classes already cover the content as a review.
2. **Students that have taken BME 241 prior to Fall 2020 but have not taken BME 211, 221, and/or 231 will still be required to take these courses.** Most of the lab modules, especially those in BME 221 and 231, will be brand new and not carry over from BME 241. Even

though most of the BME 211 labs will transfer over from BME 241, they will comprise a small enough portion of the technical content that overlap will be minimal.

3. **We will offer both versions of BME 241 in Fall 2020 (as needed) to accommodate students on both the old and new curriculum.** Our rough estimates indicate that approximately 40 students will fall under the old BME 241 curriculum requirements. These students will have the option to take the modified BME 241, since our ABET outcomes for experimentation and communication are also covered by other courses (BME 458 and BME 450/1/2). However, for those that want the hands-on experience, we can create a temporary section(s) of BME 499 to run a version of the old BME 241.
4. **No transition plan is necessary for the change from concentrations to “Depth Requirements”.** Because existing BME concentration courses will remain electives under “Depth Requirements” and the new requirements only expands course options to other science, engineering, entrepreneurship, and math departments, there should not be any conflicts for students under the new or old curriculum.
5. **Students under the old curriculum that take BME 350 Fall Term 2020 or later will be able to take one less concentration or general elective requirement to maintain 128 credit hours for the program.**

V. The following documents are attached to this memorandum:

- a. BME Curriculum as of Fall 2019
- b. BME Sample Schedule as of Fall 2019
- c. Proposed BME Curriculum for Fall 2020
- d. Proposed BME Sample Schedule for Fall 2020
- e. Proposed BME Depth Requirements and Tracks
- f. CARF – 211 (content) – Shifted lab modules from BME 241 to BME 211
- g. CARF – 221 (prereqs, content) – Added lab modules, removed some course content
- h. CARF – 231 (content) – Added lab modules, removed some course content
- i. CARF – 241 (title, description, content) – Updating title and content to reflect new focus
- j. CARF – 321 (prereqs) – Removed biochem as a prerequisite
- k. CARF – 350 (credits) – Increased credits from 3 to 4
- l. CARF – 418 (prereqs) – Removed biochem as a prerequisite
- m. CARF – 419 (prereqs) – Removed biochem as a prerequisite
- n. CARF – 451 (prereqs) – Added BME 350 as a prerequisite
- o. CARF – 458 (prereqs) – Removed BME 241 as a prerequisite

Biomedical Engineering Curriculum: Current (as of Fall 2019)

First Year	Fall	Credits	Winter	Credits	First Year
	MATH 115: Calculus I	4	MATH 116: Calculus II	4	
	CHEM 130: General Chemistry	3	CHEM 210: Structure & Reactivity	3	
	ENGR 100: Intro to Engineering Intellectual Breadth	4 4	CHEM 211: Investigations in Chemistry ENGR 101: Intro Computers & Programming BIOL 172 or 174: Intro Biology	2 4 4	
	<i>Total Credits:</i>		15	<i>Total Credits:</i>	
Second Year	Fall	Credits	Winter	Credits	Second Year
	MATH 215: Calculus III	4	MATH 216: Calculus IV	4	
	PHYS 140: General Physics I	4	BME 231: Intro to Biomechanics	4	
	PHYS 141: Elementary Lab I	1	PHYS 240: General Physics I	4	
	MSE 250: Principles of Engineering Materials Intellectual Breadth	4 4	PHYS 241: Elementary Lab I Intellectual Breadth	1 4	
<i>Total Credits:</i>		17	<i>Total Credits:</i>		17
Third Year	Fall	Credits	Winter	Credits	Third Year
	BME 211: Circuits & Systems	4	BME 241: Biomedical Undergrad Laboratory	4	
	BME 221: Biophysical Chemistry & Thermodynamics	4	BME 350: Intro to Biomedical Engineering Design	3	
	Biochem (MCDB 310, CHEM 351 or BIOLCHEM 415) Intellectual Breadth	3-4 4	BME 418: Quantitative Cell Biology Concentration Elective General Elective	3 4 3	
	<i>Total Credits:</i>		15-16	<i>Total Credits:</i>	
Fourth Year	Fall	Credits	Winter	Credits	Fourth Year
	BME 419: Quantitative Physiology	4	BME 450: Biomedical Engineering Design	4	
	BME 458: Biomedical Instrumentation Lab	4	Concentration Elective	3	
	Concentration Elective General Elective	4 4	Concentration Elective General Elective	3 4	
	<i>Total Credits:</i>		16	<i>Total Credits:</i>	

Biomedical Engineering Sample Schedule **Current: AY 2019-2020**

	Credit Hours	1	2	3	4	5	6	7	8
Subjects Required by all Programs (53 hours)									
Mathematics 115, 116, 215, 216	16	4	4	4	4	-	-	-	-
Engineering 100, Introduction to Engineering	4	4	-	-	-	-	-	-	-
Engineering 101, Introduction to Computers	4	-	4	-	-	-	-	-	-
Chemistry 130 ¹	3	3	-	-	-	-	-	-	-
Physics 140 with Lab 141; Physics 240 with Lab 241 ²	10	5	5	-	-	-	-	-	-
Intellectual Breadth	16	-	4	4	4	4	-	-	-
Advanced Science and Math (12 hours)									
Biology 172 or 174, Introduction to Biology (If using AP Bio credit (195), then Bio 173 (2) is required.)	4	-	-	-	4	-	-	-	-
Chemistry 210/211, Structure and Reactivity I and Lab	5	-	-	5	-	-	-	-	-
MCDB 310, Introduction to Biological Chemistry or BIOCHEM 415, Introduction to Biological Chemistry or Chemistry 351, Fundamentals of Biochemistry	3	-	-	-	-	-	3	-	-
Required Program Subjects (36 hours)									
BIOMEDE 211, Circuits & Systems for Biomedical Engineers	4	-	-	-	-	4	-	-	-
BIOMEDE 221, Biophysical Chemistry & Thermodynamics	4	-	-	-	-	4	-	-	-
BIOMEDE 231, Introduction to Biomechanics	4	-	-	-	4	-	-	-	-
BIOMEDE 241, Biomedical Undergraduate Lab	4	-	-	-	-	4	-	-	-
BIOMEDE 350, Introduction to Biomedical Design	3	-	-	-	-	-	3	-	-
BIOMEDE 418, Quantitative Cell Biology	3	-	-	-	-	-	3	-	-
BIOMEDE 419, Quantitative Physiology	4	-	-	-	-	-	-	4	-
BIOMEDE 450, Biomedical Design or	4	-	-	-	-	-	-	-	4
BIOMEDE 451, Biomedical Design, Part I	2	-	-	-	-	-	-	2	-
and BIOMEDE 452, Biomedical Design, Part II	3	-	-	-	-	-	-	-	3
BIOMEDE 458, Biomedical Instrumentation & Design	4	-	-	-	-	-	-	4	-
MATSCIE 250, Principles of Engineering Materials	4	-	-	4	-	-	-	-	-
Concentration Requirements and Electives ³ (14hours)	14	-	-	-	-	-	4	4	6
General Electives (11 hours)	11	-	-	-	-	-	4	4	3
Total	128	16	17	17	16	16	17	16-18	12-13

Revised: April-18

Candidates for the Bachelor of Science in Engineering in Biomedical Engineering - B.S.E. in Biomed E. - must complete the program listed above. This sample schedule is an example of one leading to graduation in eight terms.

Notes:

- ¹If you have a satisfactory score or grade in Chemistry AP, A-Level, IB Exams or transfer credit from another institution for Chemistry 130/125/126 you will have met the Chemistry Core Requirement for the College of Engineering.
- ²If you have a satisfactory score or grade in Physics AP, A-Level, IB Exams or transfer credit from another institution for Physics 140/141 and 240/241 you will have met the Physics Core Requirement for the College of Engineering.
- ³Concentration requirements and electives: A list of approved courses is available on the department website and in 1111 Gerstacker.

Biomedical Engineering Curriculum: Effective Fall 2020

	Fall		Winter	
		Credits		Credits
First Year	MATH 115: Calculus I	4	MATH 116: Calculus II	4
	CHEM 130: General Chemistry	3	PHYS 140: General Physics I	4
	CHEM 125/126: General Chemistry Lab I & II	2	PHYS 141: Elementary Lab I	1
	ENGR 100: Intro to Engineering Intellectual Breadth	4	ENGR 101: Intro Computers & Programming	4
		4	BIOL 172 or 174: Intro Biology	4
	<i>Total Credits:</i>	17	<i>Total Credits:</i>	17
Second Year	MATH 215: Calculus III	4	MATH 216: Calculus IV	4
	BME 221: Biophysical Chemistry & Thermodynamics	4	BME 211: Circuits & Systems	4
	BME 241: Statistics, Computation, & Data Analysis	4	BME 231: Intro to Biomechanics	4
	PHYS 240: General Physics I	4	Intellectual Breadth	4
	PHYS 241: Elementary Lab I	1		
	<i>Total Credits:</i>	17	<i>Total Credits:</i>	16
Third Year	BME 350: Intro to Biomedical Engineering Design	4	BME 458: Biomedical Instrumentation Lab	4
	BME 418: Quantitative Cell Biology	3	Depth Elective	3
	MSE 250: Principles of Engineering Materials	4	Depth Elective	3
	Intellectual Breadth	4	Intellectual Breadth	4
			General Elective	3
	<i>Total Credits:</i>	15	<i>Total Credits:</i>	17
Fourth Year	BME 419: Quantitative Physiology	4	BME 450: Biomedical Engineering Design	4
	Depth Elective	4	Depth Elective	4
	Depth Elective	4	Depth Elective	3
	General Elective	3	General Elective	3
		<i>Total Credits:</i>	15	<i>Total Credits:</i>

Red indicates modified or newly added course to the curriculum

Biomedical Engineering Sample Schedule

Proposed for Fall 2020

	Credit Hours	1	2	3	4	5	6	7	8
Subjects Required by all Programs (55 hours)									
Mathematics 115, 116, 215, 216	16	4	4	4	4	-	-	-	-
Engineering 100, Introduction to Engineering	4	4	-	-	-	-	-	-	-
Engineering 101, Introduction to Computers	4	-	4	-	-	-	-	-	-
Chemistry 125/126 and 130 or Chemistry 210 and 211 ¹	5	5	-	-	-	-	-	-	-
Physics 140 with Lab 141; Physics 240 with Lab 241 ²	10	-	5	5	-	-	-	-	-
Intellectual Breadth	16	4	-	-	4	4	4	-	-
Life and Materials Science and Engineering (8 hours)									
Biology 172 or 174, Introduction to Biology ³	4	-	4	-	-	-	-	-	-
MATSCIE 250, Principles of Engineering Materials	4	-	-	-	-	4	-	-	-
Required Program Subjects (35 hours)									
BIOMEDE 211, Circuits & Systems for Biomedical Engineers	4	-	-	-	4	-	-	-	-
BIOMEDE 221, Biophysical Chemistry & Thermodynamics	4	-	-	4	-	-	-	-	-
BIOMEDE 231, Introduction to Biomechanics	4	-	-	-	4	-	-	-	-
BIOMEDE 241, Statistics, Computation, and Data Analysis	4	-	-	4	-	-	-	-	-
BIOMEDE 350, Introduction to Biomedical Design	4	-	-	-	-	4	-	-	-
BIOMEDE 418, Quantitative Cell Biology	3	-	-	-	-	3	-	-	-
BIOMEDE 419, Quantitative Physiology	4	-	-	-	-	-	-	4	-
BIOMEDE 450, Biomedical Design or	4	-	-	-	-	-	-	-	4
BIOMEDE 451, Biomedical Design,	3	-	-	-	-	-	-	3	-
Part I and BIOMEDE 452, Biomedical Design, Part II	3	-	-	-	-	-	-	-	3
BIOMEDE 458, Biomedical Instrumentation & Design	4	-	-	-	-	-	4	-	-
Depth Requirements⁴ (21 hours)									
Engineering Expertise	12	-	-	-	-	-	-	8	4
Advanced Science, Technology, Engineering or Math	6	-	-	-	-	-	3	-	3
Experiential Elective	3	-	-	-	-	-	3	-	-
General Electives (9 hours)	9	-	-	-	-	-	3	3	3
Total	128	17	17	17	16	15	17	15-18	13-14

Candidates for the Bachelor of Science in Engineering in Biomedical Engineering - B.S.E. in Biomed E. - must complete the program listed above. This sample schedule is an example of one leading to graduation in eight terms.

Notes:

¹-If you have a satisfactory score or grade in Chemistry AP, A-Level, IB Exams or transfer credit from another institution for Chemistry 130/125/126 you will have met the Chemistry Core Requirement for the College of Engineering.

²-If you have a satisfactory score or grade in Physics AP, A-Level, IB Exams or transfer credit from another institution for Physics 140/141 and 240/241 you will have met the Physics Core Requirement for the College of Engineering.

³- If you have a satisfactory score or grade in Biology AP, A-Level, IB Exams or transfer credit from another institution for Biology 172/174 you will have met the Biology Requirement for BME.

⁴-Depth requirements: A list of depth requirements and optional tracks is available on the department website and in 1111 Gerstacker.

BME Depth Requirements

Depth Requirements consist of 21 credit hours, which must satisfy criteria in the following three areas:

Engineering Expertise (12 credits)

- 12 credits of engineering courses
- At least 6 credits must be BME courses
- All courses must be at the 300 level or higher
- Seminar courses and independent research do NOT fulfill this requirement
- Some BME 499 courses may count but must be approved by petition to the BME Undergraduate Education Committee (UEC)

Advanced Science, Technology, Engineering, or Math (STEM, 6 credits)

- 6 credits of courses in science, engineering, math, or related technical field (e.g. Entrepreneurship, Bioinformatics, Movement Science, Med School Department)
- Courses must be at the 200 level or higher
- Science courses must be designated as natural science (NS) in the LSA Course Guide
- Up to 1 credit of seminar may count
- Courses taken under Engineering Expertise and Experiential Electives that exceed the minimum requirements (i.e. 12 credits and 3 credits, respectively) may count; credits may be split (e.g. a 4 credit lab may have 3 credits count for the Experiential Elective and 1 credit for Advanced STEM)

Experiential Electives (3 credits)

- 3 credits of a course that is primarily hands-on or experiential learning (e.g. lab, design, practicum, or research)
- Courses must fall under science, engineering, entrepreneurship or computation
- BME 499: BME-in-Practice, BME 499: Clinical Observation and Needs Finding, Multidisciplinary Design Program (up to 3 credits) and some Entrepreneurship courses satisfy this requirement
- Up to 2 credits of BME 452 (Biomedical Design II) may count towards this requirement
- Independent Research (e.g. BME 490 or UROP) may count if it is science or engineering-focused. Approval must be received by petition to the BME Undergraduate Education Committee (UEC)

Courses cannot be taken Pass/Fail. Students must earn a C- or better in all courses. Elected courses cannot have substantial overlap with other BME core courses or others taken to satisfy the requirements (e.g. EECS 314 overlaps with BME 211 and will not count as a Depth Requirement).

Neural Engineering

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 410	Biomaterials
BME 417	Electrical Biophysics
BME 516	Medical Imaging Systems
BME 517	Neural Engineering
EECS 311	Analog Circuits
EECS 320	Intro to Semiconductor Devices
EECS 351	Intro to Digital Signal Processing
EECS 373	Intro to Embedded Systems
EECS 414	Intro to MEMS

Advanced STEM

(6 credits: 200-level+ math, natural science, and/or engineering)

EECS 216	Signals and Systems
MATH 371	Numerical Methods for Engineers
MATH 417	Matrix Algebra I
MATH 463	Math Modeling of Biology
MATH 465	Intro to Combinatorics
MATH 568	Math and Computational Neuroscience
MCDB 451	Molecular Neurobio of Health and Disease
MCDB 455	Cell Biology of Neurodegeneration

Experiential Elective (3 credits)

BME 510	Medical Imaging lab
EECS 200	Electrical Engineering Systems Design I
MCDB 423	Neurobiology Lab
MCDB 424	Behavioral Neurobiology Lab

Biomedical Imaging and Bioelectrics

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 442	Intro to Biomedical Imaging
BME 481	Engineering Prin of Radiation Imaging
BME 484	Radiological Health Engin Fundmls
BME 516	Medical Imaging Systems
EECS 334	Principles of Optics
EECS 351	Intro to Digital Signal Processing
EECS 445	Machine Learning
EECS 556	Image Processing

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

BIOPHYS 440	Biophysics of Diseases
CBD	Quant Fluoro Microscopy & Image Anal
EECS 216	Signals and Systems
MATH 371	Numerical Methods for Engineers
MATH 417	Matrix Algebra I
MATH 463	Math modeling of Biology
NERS 250	Fundmls of Nuclear Eng & Rad Sciences
NERS 312	Elements of Nuclear Eng Rad Sciences II
MCDB 451	Molecular Neurobio of Health and Disease
MCDB 455	Cell Biology of Neurodegeneration

Experiential Elective (3 credits)

BME 510	Medical Imaging Lab
BIOPHYS 422	Experimental Methods in Structural Bio
BIOPHYS 450	Biophys Chem II: Macromol Struc & Dyn
MCDB 423	Neurobiology Lab

Biocomputation

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 311	Signals and Systems
Or EECS 216	
BME 499.060	AI in BME
BME 417	Electrical Biophysics
BME 517	Neural Engineering
BME 599	Comp Tools for Genomic Technologies
EECS 445	Machine Learning
EECS 485	Web Databases & Information Systems
EECS 492	Artificial Intelligence

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

BIOINF 540/ MATH 540	Math of Biological Networks
BIOINF 547	Probabilistic Modeling in Bioinformatics
EECS 203	Discrete Math
EECS 280	Programming and Intro Data Structures
EECS 281	Data Structures and Algorithms
EECS 285	Programming in Java
MATH 214/ MATH 217	Linear Algebra
MATH 371	Numerical Methods for Engineers

Experiential Elective (3 credits)

BIOINF 527	Intro to Bioinformatics & Computational Bio
EECS 441	Mobile App Developmt for Entrepreneurs
EECS 460	Control Systems, Analysis, and Design

Biomechanics

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 331	Intro to Biofluid Mechanics
BME 332	Intro Biosolid Mechanics
BME 456	Modeling in Biosolid Mechanics
BME 476	Advanced Biofluid Mechanics
BME 479	Biotransport
EECS 414	Intro to MEMS
IOE 333	Ergonomics
IOE 463	Measurement and Design of Work
IOE 491	Applied Physical Ergonomics
BME 534	Occupational Biomechanics /IOE
IOE 438	Occupational Safety Management
ME 250	Design & Manufacturing I
ME 360	Model, Anal & Control of Dynamic Systems
ME 406	Biomechanics for Engineering Students
ME 553	Microelectromechanical Systems

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

ANAT 403	Human Body
BIOINF 540/ MATH 540	Math of Biological Networks
MATH 214/ MATH 217	Linear Algebra
MoveSci 230	Musculoskeletal Anatomy
MoveSci 231	Musculoskeletal Anatomy Lab
MoveSci 435	Biomechanics of Human Locomotion

Experiential Elective (3 credits)

BME 474	Intro to Tissue Engineering
ME 250	Design & Manufacturing I
ME 482	Machining processes
EECS 467	Autonomous Robots
EECS 367	Intro to Autonomous Robots
ME 553	Microelectromechanical Systems

Tissue Engineering and Regenerative Medicine

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 321	Bioreaction Engineering and Design
BME 331	Intro Biofluid Mechanics
BME 332	Intro Biosolid Mechanics
BME 410	Biomaterials
BME 456	Modeling in Biosolid Mechanics
BME 474	Tissue Engineering
BME 479	Biotransport
BME 504	Cellular Biotechnology
BME 563/ CHE 563/MSE 563	Biomolecular Engineering of Interfaces
CHE 558/ MSE 558	Foundations of Nanotechnology I
CHE 559/ MSE 559	Foundations of Nanotechnology II
ME 406	Biomechanics for Engineering Students
MSE 583	Biocompatibility of Materials

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

CDB 450	From Stem Cells to Tissues and Organs
MCDB 436	Human Immunology
PHYSIOL 415	Lab Techniques in Biomedical Research
STATS 403	Intro to Quant Research Methods

Experiential Elective (3 credits)

BIO 226	Human and Animal Physiology Lab
BiolChem 416	Intro to Biochem Lab
CHEM 246	Biomedical Analytical Chemistry Lab I
CHEM 247	Biomedical Analytical Chemistry Lab II
MCDB 429	Lab in Cell and Molecular Biology
MSE 350	Structures of Materials
MSE 360	Materials Lab I

Biotechnology and Pharmaceutical Engineering

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 321	Bioreaction Engineering and Design
BME 331	Intro Biofluid Mechanics
BME 332	Intro Biosolid Mechanics
BME 410	Biomaterials
BME 474	Intro to Tissue Engineering
BME 476	Adv Biofluid Mechanics
BME 479	Biotransport

BME 504	Cellular Biotechnology
CHE 516	Applied Pharmacokinetics & Toxicokinetics
CHE 517	Biopharmaceutical Engineering
CHE 519	Pharmaceutical Engineering
CHE 558/ MSE 558	Foundations of Nanotechnology I
CHE 559/ MSE 559	Foundations of Nanotechnology II
CHE 574	Eng Prin in Drug Delivery & Targeting
CHE 597	Regulatory Issues for Scientists, Engineers, & Managers
CHE 696	Tech Innovation, Law, & Regulation

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

BIO 207	Intro Microbiology
CDB 450	From Stem Cells to Tissues and Organs
CHEM 210	Organic Chemistry I
CHEM 245	Biomedical Analytical Chemistry
ENTR 500	Intro to Innovation
ENTR 560	Project Management & Consulting
560.001 & 560.002	
MATH 463	Math Modeling of Biology
MATH 540/ BIOINF 540	Math of Biological Networks
MCDB 310	Biochemistry
Or BiolChem 415 or CHEM 351	
MCDB 408	Genomic Biology
MCDB 436	Human Immunology
MicroBiol 405	Medical Microbio & Infectious Diseases
Pharmacol 310	Pharmacology and Therapeutics

Experiential Elective (3 credits)

BIO 226	Human and Animal Physiology Lab
BiolChem 416	Intro to Biochem Lab
CHEM 211	Organic Chemistry Lab
CHEM 216	Organic Chemistry Lab II
CHEM 246	Biomedical Analytical Chemistry Lab I
CHEM 247	Biomedical Analytical Chemistry Lab II
MCDB 429	Lab in Cell and Molecular Biology
PHYSIOL 404	Human Physiology Lab

Pre-Health

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 321	Bioreaction Engineering and Design
BME 331	Intro Biofluid Mechanics

BME 332	Intro Biosolid Mechanics
BME 410	Biomaterials
BME 442	Biomedical Imaging
BME 474	Intro to Tissue Engineering
BME 479	Biotransport
BME 499.002	Clinical Observation and Needs Finding
BME 504	Cellular Biotechnology
CHE 519	Pharmaceutical Engineering
IOE 333	Ergonomics
MSE 583	Biocompatibility of Materials

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

ANAT 403	Human Body
BIO 207	Microbiology
CDB 450	From Stem Cells to Tissues and Organs
CHEM 210	Organic Chemistry I
CHEM 215	Organic Chemistry II
CHEM 245	Biomedical Analytical Chemistry
MCDB 310	Biochemistry
or BIOLCHEM 415 or CHEM 351	
MCDB 408	Genomic Biology
MCDB 436	Human Immunology
Pharmacol 310	Pharmacology and Therapeutics

Experiential Elective (3 credits)

BIO 226	Human and Animal Physiology Lab
BiolChem 416	Intro to Biochem Lab
CHEM 211	Organic Chemistry Lab
CHEM 216	Organic Chemistry Lab II
CHEM 246	Biomedical Analytical Chemistry Lab I
CHEM 247	Biomedical Analytical Chemistry Lab II
CHEM 352	Intro to Biochemical Research Techniques
MCDB 429	Lab in Cell and Molecular Biology
PHYSIOL 404	Human Physiology Lab

Medical Device Development

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 331	Intro Biofluid Mechanics
BME 332	Intro Biosolid Mechanics
BME 456	Modeling in Biosolid Mechanics
BME 476	Adv Biofluid Mechanics
BME 479	Biotransport
BME 503	Statistical Methods for BME
BME 588	Global Quality Systems and Regulatory Innovation

CHE 597	Regulatory Issues for Scientists, Engineers, and Managers
CHE 696	Tech Innovation, Law, & Regulation
ME 350	Design and Manufacturing II
ME 452	Design for Manufacturability
ME 481	Manufacturing Processes
ME 482	Machining Processes
IOE 333	Ergonomics
IOE 463	Measurement and Design of Work

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

ANAT 403	Human Body
ENTR 413	Entrepreneurship Marketing & 599.413
ENTR 408	Patent Law & 599.408
ENTR 500	Intro to Innovation
ENTR 520	Technology-Inspired Business Models
ENTR 530	Innovation & IP Strategy
ENTR 550	Interpersonal Skills
ENTR 560	Project Management Consulting 560.001 and 560.002
MATH 214/	Linear Algebra
MATH 217	
MATH 463	Math Modeling of Biology
MATH 540/	Math of Biological Networks
BIOINF 540	
Stat 470	Intro to Design of Experiments
Stat 570	Design of Experiments

Experiential Elective (3 credits)

BME 499.002	Clinical Observation and Needs Finding
BME 499	BME-in-Practice
EECS 200	Electrical Engineering Systems Design I
ENTR 390.005	Intro to Entrepreneurial Design
ENTR 390.012	Digital Product Design
ENTR 412	Advanced Entrepreneurship Practicum
ME 250	Design and Manufacturing I
ME 350	Design and Manufacturing II
ME 553	Microelectromechanical Systems
PHYSIOL 404	Human Physiology Lab

Systems Biology Concentration

Engineering Expertise

(12 credits: 6 BME, 6 any CoE)

BME 321	Bioreaction Engineering and Design
BME 331	Intro Biofluid Mechanics
BME 332	Intro Biosolid Mechanics
BME 474	Tissue Engineering
BME 479	Biotransport
BME 499.060	AI in BME
BME 504	Cellular Biotechnology
CHE 519	Pharmaceutical Engineering
ME 360	Model, Anal & Control of Dynamic Systems

Advanced STEM (6 credits: 200-level+ math, natural science, and/or engineering)

ANAT 403	Human Body
BIO 207	Microbiology
BIO 272	Fundamentals of Cell Biology
BIOINF 540/	Mathematics of Biological Networks
MATH 540	
BIOINF 547	Probabilistic Modeling in Bioinformatics
MCDB 408	Genomic Biology
MCDB 416	Introduction to Bioinformatics
MCDB 436	Human Immunology
MCDB 441	Cell Biology and Disease
MCDB 456	Genes, Circuits, and Behavior
MCDB 469	Signal Transduction
MICRBIOL 405	Medical Microbiology & Infectious Disease
MATH 214	Linear Algebra
or MATH 217	
PhrmaCol 310	Pharmacology and Therapeutics

Experiential Elective (3 credits)

BIO 226	Human and Animal Physiology Lab
BIOINF 527	Intro to Bioinformatics & Computational Bio
CHEM 352	Intro to Biochemical Research Techniques
MCDB 429	Laboratory in Cell and Molecular Biology
PHYSIOL 404	Human Physiology Lab



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-07

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 211	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 211												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Circuits and Systems for Biomedical Engineering	Course Title (full title) Circuits and Systems for Biomedical Engineering												
<input type="checkbox"/>	Abbreviated Title (20 char) Circuits and Systems	Abbreviated Title (20 char) Circuits and Systems												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Students learn circuits and linear systems concepts necessary for analysis and design of biomedical systems. Theory is motivated by examples from biomedical engineering. Topics covered include electrical circuit fundamentals, operational amplifiers, frequency response, electrical transients, impulse response, transfer functions, and convolution, all motivated by circuit and biomedical examples. Elements of continuous time domain-frequency domain analytical techniques are developed.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 211	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input type="checkbox"/>	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
<input type="checkbox"/>	Enforced Prerequisite (254 char) MATH 216 or 256 or 286 and PHYSICS 240 or 260 Minimum grade requirement: C-	Enforced Prerequisite (254 char) MATH 216 or 256 or 286 and PHYSICS 240 or 260 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input checked="" type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
		<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input checked="" type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>
Cognizant Faculty Member Name: Barry Belmont		Cognizant Faculty Member Title: Lecturer III

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Students learn circuits and linear systems concepts necessary for analysis and design of biomedical systems. Theory is motivated by examples from biomedical engineering. Topics covered include electrical circuit fundamentals, operational amplifiers, frequency response, electrical transients, impulse response, transfer functions, and convolution, all motivated by circuit and biomedical examples. Elements of continuous time domain-frequency domain analytical techniques are developed.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)Course Description

Students learn circuits and linear systems concepts necessary for analysis and design of biomedical systems. Theory is motivated by examples from biomedical engineering. Topics covered include electrical circuit fundamentals, operational amplifiers, frequency response, electrical transients, impulse response, transfer functions, and convolution, all motivated by circuit and biomedical examples. Elements of continuous time domain-frequency domain analytical techniques are developed.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)

1

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 211 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

Existing circuits lab modules (4 modules) from BIOMEDE 241 will be integrated into BIOMEDE 211 to provide hands-on reinforcement of key concepts. These labs will take place every 3–4 weeks. To accommodate the additional lab component, some course content covering the digital domain will be removed along with one homework assignment.



Course Approval Request Form

Office of the Registrar, University of Michigan

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500 S. State Street

Ann Arbor, MI 48109-1382

Phone: 734.763.2113

Fax: 734.936.3148

ro.curriculum@umich.edu

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CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-07

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 221	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 221												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Biophysical Chemistry and Thermodynamics	Course Title (full title) Biophysical Chemistry and Thermodynamics												
<input type="checkbox"/>	Abbreviated Title (20 char) Biophy Chemistry	Abbreviated Title (20 char) Biophy Chemistry												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course covers the physico-chemical concepts and processes relevant to life. The emphasis lies on the molecular level. Topics: Biomimetics; Energy and Driving Forces; Biochemical Equilibria; Aqueous Solutions; Molecular Self-Assembly; Bio-electrochemistry; Biopolymers; Molecular Recognition and Binding Equilibria in Biology.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 221

<input type="checkbox"/>	Grading Basis		
	<input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration	Add Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent	Drop Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent
	Grading		
	<input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only		

CURRENT LISTING**REQUESTED LISTING**

<input type="checkbox"/>	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) CHEM 210 and MATH 116 or 156 Minimum grade requirement: C-	Enforced Prerequisite (254 char) CHEM 130 and MATH 116 or 156 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input checked="" type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
		Terms Typically Offered <input checked="" type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer
Cognizant Faculty Member Name: Melissa Wrobel		Cognizant Faculty Member Title: Lecturer III

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu

Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

This course covers the physico-chemical concepts and processes relevant to life. The emphasis lies on the molecular level. Topics: Biomimetics; Energy and Driving Forces; Biochemical Equilibria; Aqueous Solutions; Molecular Self-Assembly; Bio-electrochemistry; Biopolymers; Molecular Recognition and Binding Equilibria in Biology.

Recommended concurrent enrollment in Biol 310 or 311 or BiolChem 415 or 451.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)Course Description

This course covers the physico-chemical concepts and processes relevant to life. The emphasis lies on the molecular level. Topics: Biomimetics; Energy and Driving Forces; Biochemical Equilibria; Aqueous Solutions; Molecular Self-Assembly; Bio-electrochemistry; Biopolymers; Molecular Recognition and Binding Equilibria in Biology.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)

1

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 221 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

Lab modules (3–4) will be integrated into the course to provide hands-on reinforcement of key concepts. These labs will take place every 3–4 weeks. Some content currently covered in lecture will be shifted to the lab (e.g. microcalorimetry, liposome self-assembly, ligand or enzyme binding) and only assessed in lab, thus keeping the course content the same and reducing the length and/or number of homeworks and exams that cover these topics.

Removed organic chemistry as a prerequisite to align with curriculum requirement changes; basic organic chemistry concepts already overlap with BIOMEDE 221.



Course Approval Request Form
Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
- Modification of Existing Course
- Deletion of Existing Course

Date of Submission: 2019-11-08
Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 231	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 231												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Introduction to Biomechanics	Course Title (full title) Introduction to Biomechanics												
<input type="checkbox"/>	Abbreviated Title (20 char) Intro Biomechanics	Abbreviated Title (20 char) Intro Biomechanics												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course provides students with an introduction to topics in biomechanics, including statics, dynamics, and deformable body mechanics, as they apply to biological tissues and systems.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 231	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input type="checkbox"/>	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
<input type="checkbox"/>	Enforced Prerequisite (254 char) MATH 116 or 156 and PHYSICS 140 or 160 Minimum grade requirement: C-	Enforced Prerequisite (254 char) MATH 116 or 156 and PHYSICS 140 or 160 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input checked="" type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
		<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input checked="" type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>
Cognizant Faculty Member Name: Brendon Baker		Cognizant Faculty Member Title: Assistant Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

This course provides students with an introduction to topics in biomechanics, including statics, dynamics, and deformable body mechanics, as they apply to biological tissues and systems.

Course Description

This course provides students with an introduction to topics in biomechanics, including statics, dynamics, and deformable body mechanics, as they apply to biological tissues and systems.

Class Length

Full term

Class Length

Full term

Contact hours (lecture):

4

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (recitation)Contact hours (lab)Contact hours (lab)

1

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 231 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

Lab modules (3–4) will be integrated into the course to provide hands-on reinforcement of key concepts. These labs will take place every 3–4 weeks. Currently, the course is divided into 3 sections: 1.) statics 2.) dynamics 3.) mechanics of materials. A lab would be created to reinforce concepts in each section. To maintain the total amount of effort for students, 2–3 lectures could be eliminated. Lecture content associated with mechanics of materials contains some overlap with MATSCIE 250 and could be reduced. The mechanics of materials concepts could also be primarily covered through the labs instead of lecture, resulting in fewer homeworks and less coverage on an exam.



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ro.curriculum@umich.edu
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CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
- Modification of Existing Course
- Deletion of Existing Course

Date of Submission: 2019-11-08
Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 241	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 241												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input checked="" type="checkbox"/>	Course Title (full title) Biomedical Engineering Undergraduate Laboratory	Course Title (full title) Statistics, Computation, and Data Analysis												
<input checked="" type="checkbox"/>	Abbreviated Title (20 char) BiomedE Ugrad Lab	Abbreviated Title (20 char) Stats Comp Data Anal												
<input checked="" type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course integrates the fundamentals of statistics, data analysis, computational methods, and data visualization to address real world biomedical problems. Lectures cover descriptive statistics, discrete and random distributions, hypothesis testing, regression, ANOVA and post-hoc tests. Laboratories focus on applying statistical and computational methods to real data sets from biomedical engineering.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 241	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BiomedE 221, 231	Advisory Prerequisite (254 char)
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) BiomedE 211 Minimum grade requirement: C-	Enforced Prerequisite (254 char) ENGR 101 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input checked="" type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
		<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input checked="" type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>
Cognizant Faculty Member Name: Cindy Chestek		Cognizant Faculty Member Title: Associate Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Provides a hands-on introduction to the construction and characterization of electronic circuits, the acquisition and display of biopotentials, measurement and analysis of the mechanical properties of biological and non-biological materials, and basic cell culture techniques including live-dead assays and assessment of cell adhesion properties.

Course Description

This course integrates the fundamentals of statistics, data analysis, computational methods, and data visualization to address real world biomedical problems. Lectures cover descriptive statistics, discrete and random distributions, hypothesis testing, regression, ANOVA and post-hoc tests. Laboratories focus on applying statistical and computational methods to real data sets from biomedical engineering.

Class Length

Full term

Class Length

Full term

Contact hours (lecture):

4

Contact hours (lecture):

2

Contact hours (recitation)Contact hours (recitation)Contact hours (lab)Contact hours (lab)

2

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 241 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1, 3, 6

Special resources of facilities required for this course:Supporting statement:

In response to feedback from students and industry, the course was restructured to focus on statistics, incorporate programming, data analysis and visualization, and remove the lab modules associated with circuits, mechanics of materials, and cell assays. With the rise of big data in many biomedical fields, electronic medical records, and security of medical devices, there is a need to provide the basic skills and knowledge to tackle these challenges.



Course Approval Request Form

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CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-08

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 321	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 321												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Bioreaction Engineering and Design	Course Title (full title) Bioreaction Engineering and Design												
<input type="checkbox"/>	Abbreviated Title (20 char) Bioreaction	Abbreviated Title (20 char) Bioreaction												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course introduces topics in enzyme kinetics, enzyme inhibition, biochemical pathway engineering, mass and energy balance, cell growth and differentiation, cell engineering, bioreactor design, and analysis of the human body, organs, tissues, and cells as bioreactors. The application of bioreaction/bioreactor principles to tissue engineering is also discussed.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: Undergraduate Max: 3 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatabile for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 321				
<input type="checkbox"/>	<table style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 33%; vertical-align: top;"> Grading Basis <input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration Grading <input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only </td> <td style="width: 33%; vertical-align: top;"> Add Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent </td> <td style="width: 33%; vertical-align: top;"> Drop Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent </td> </tr> </table>	Grading Basis <input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration Grading <input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only	Add Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent	Drop Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent
Grading Basis <input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration Grading <input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only	Add Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent	Drop Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent		

	CURRENT LISTING	REQUESTED LISTING			
<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BiomedE 221 , Bio 310 (310 can be concurrent)	Advisory Prerequisite (254 char)			
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) BIOMEDE 221 Minimum grade requirement: C-			
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions			
<input type="checkbox"/>	<table style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 33%; vertical-align: top;"> Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study </td> <td style="width: 33%; vertical-align: top;"> Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </td> <td style="width: 33%; vertical-align: top;"> Terms Typically Offered <input type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer </td> </tr> </table>	Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Terms Typically Offered <input type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer	
Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Terms Typically Offered <input type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer			
Cognizant Faculty Member Name: Mohammad Fallahi-Sichani Cognizant Faculty Member Title: Assistant Professor					

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

This course introduces topics in enzyme kinetics, enzyme inhibition, biochemical pathway engineering, mass and energy balance, cell growth and differentiation, cell engineering, bioreactor design, and analysis of the human body, organs, tissues, and cells as bioreactors. The application of bioreaction/bioreactor principles to tissue engineering is also discussed.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)Course Description

This course introduces topics in enzyme kinetics, enzyme inhibition, biochemical pathway engineering, mass and energy balance, cell growth and differentiation, cell engineering, bioreactor design, and analysis of the human body, organs, tissues, and cells as bioreactors. The application of bioreaction/bioreactor principles to tissue engineering is also discussed.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 321 is an elective course within the biomedical engineering curriculum.

ABET departmental program outcomes for undergraduate courses:

Not ABET accredited

Special resources of facilities required for this course:Supporting statement:

Removed biochemistry as an advisory prerequisite to align with the removal of biochemistry as core curriculum requirements. Any necessary biochemistry content will be introduced in BIOMEDE 221, and thus this course is added as an enforced prerequisite.



Course Approval Request Form

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Action Requested

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 Deletion of Existing Course

Date of Submission: 2019-11-08

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 350	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 350												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Introduction to Biomedical Design	Course Title (full title) Introduction to Biomedical Design												
<input checked="" type="checkbox"/>	Abbreviated Title (20 char) Intro BME Design	Abbreviated Title (20 char) Introd to BME Design												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit Maximum number of repeatable credits:													
	<input type="checkbox"/> Course is Y graded <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 350	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input checked="" type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input checked="" type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BiomedE 211, 221, 231; co-requisite BiomedE 241	Advisory Prerequisite (254 char) BIOMEDE 221 and 231
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) MATH 216 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input checked="" type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
		<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input checked="" type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>
Cognizant Faculty Member Name: Andrew Putnam		Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)Course Description

This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)

1

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 350 is a required core course for all biomedical engineering undergraduate students.

ABET departmental program outcomes for undergraduate courses:

2, 4, 5, 6, 7

Special resources of facilities required for this course:Supporting statement:

Increased BIOMEDE 350 from 3 to 4 credits and removed one credit from General Electives to accommodate this change. Now that BIOMEDE 350 has been taught several times as a required element of the curriculum since 2015, it is clear that the content is more appropriate for 4 credits instead of 3. Exposure to software tools, design thinking, and project-based learning are skills highly valued by industry, which can be taught in more depth with the additional credit hour. In addition, the course will add a 1–2 hour lab section to allow the instructor(s) to mentor student teams on their projects.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building

500 S. State Street

Ann Arbor, MI 48109-1382

Phone: 734.763.2113

Fax: 734.936.3148

ro.curriculum@umich.edu

ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-08

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 418	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 418												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Quantitative Cell Biology	Course Title (full title) Quantitative Cell Biology												
<input type="checkbox"/>	Abbreviated Title (20 char) Quant Cell Biology	Abbreviated Title (20 char) Quant Cell Biology												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course introduces the fundamentals of cell structure and functioning. The goal is to provide a general background in cell biology, with emphasis placed on physical aspects that are of particular interest to engineers.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: 3 Undergraduate Max: 3 Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student, Rackham Graduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 418	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input checked="" type="checkbox"/>	<p>Advisory Prerequisite (254 char) Phys 240, Math 216, Chem 210, BME 221, BME 241. MCDB 310 (BiolChem 41, 515, or Chem 351) is preferable, but could be taken concurrently.</p>	<p>Advisory Prerequisite (254 char) MATH 216 and PHYSICS 240</p>
<input checked="" type="checkbox"/>	<p>Enforced Prerequisite (254 char) Minimum grade requirement: C-</p>	<p>Enforced Prerequisite (254 char) BIOMEDE 221 Minimum grade requirement: C-</p>
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
	<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input checked="" type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>	
Cognizant Faculty Member Name: Kelly Arnold		Cognizant Faculty Member Title: Assistant Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

This course introduces the fundamentals of cell structure and functioning. The goal is to provide a general background in cell biology, with emphasis placed on physical aspects that are of particular interest to engineers.

Course Description

This course introduces the fundamentals of cell structure and functioning. The goal is to provide a general background in cell biology, with emphasis placed on physical aspects that are of particular interest to engineers.

Class Length

Full term

Class Length

Full term

Contact hours (lecture):

3

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (recitation)Contact hours (lab)Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 418 is a required core course in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

Removed biochemistry and organic chemistry as prerequisites to align with the removal of biochemistry and organic chemistry as core curriculum requirements. Any necessary biochemistry content will be introduced in BIOMEDE 221, and thus this course is added as an enforced prerequisite.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building

500 S. State Street

Ann Arbor, MI 48109-1382

Phone: 734.763.2113

Fax: 734.936.3148

ro.curriculum@umich.edu

ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-08

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 419	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 419												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Quantitative Physiology	Course Title (full title) Quantitative Physiology												
<input type="checkbox"/>	Abbreviated Title (20 char) Quant Physiology	Abbreviated Title (20 char) Quant Physiology												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Quantitative Physiology provides learning opportunities for senior undergraduate and graduate students to understand and develop competencies in a quantitative, research oriented, systems approach to physiology. Systems examined include cellular; musculoskeletal; cardiovascular; respiratory; endocrine; gastrointestinal; and renal. Mathematical models and engineering analyses are used to describe system performance where applicable.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit Maximum number of repeatable credits:													
	<input type="checkbox"/> Course is Y graded <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 419	
<input type="checkbox"/>	<p>Grading Basis</p> <p><input checked="" type="checkbox"/> Graded (A – E)</p> <p><input type="checkbox"/> Credit/No Credit</p> <p><input type="checkbox"/> Satisfactory/Unsatisfactory</p> <p><input type="checkbox"/> Pass/Fail</p> <p><input type="checkbox"/> Business Administration</p> <p>Grading</p> <p><input type="checkbox"/> Not for Credit</p> <p><input type="checkbox"/> Not for Degree Credit</p> <p><input type="checkbox"/> Degree Credit Only</p>
	<p>Add Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>
	<p>Drop Consent</p> <p><input type="checkbox"/> Department Consent</p> <p><input type="checkbox"/> Instructor Consent</p> <p><input checked="" type="checkbox"/> No Consent</p>

	CURRENT LISTING	REQUESTED LISTING
<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BIOLCHEM 310	Advisory Prerequisite (254 char)
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) Minimum grade requirement: C-	Enforced Prerequisite (254 char) BIOMEDE 221 Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input type="checkbox"/>	<p>Course Components</p> <p><input checked="" type="checkbox"/> Lecture</p> <p><input type="checkbox"/> Seminar</p> <p><input type="checkbox"/> Recitation</p> <p><input type="checkbox"/> Lab</p> <p><input type="checkbox"/> Discussion</p> <p><input type="checkbox"/> Independent Study</p>	<p>Graded Component</p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
		<p>Terms Typically Offered</p> <p><input checked="" type="checkbox"/> Fall</p> <p><input type="checkbox"/> Winter</p> <p><input type="checkbox"/> Spring</p> <p><input type="checkbox"/> Summer</p> <p><input type="checkbox"/> Spring/Summer</p>
Cognizant Faculty Member Name: James Grotberg		Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Quantitative Physiology provides learning opportunities for senior undergraduate and graduate students to understand and develop competencies in a quantitative, research oriented, systems approach to physiology. Systems examined include cellular; musculoskeletal; cardiovascular; respiratory; endocrine; gastrointestinal; and renal. Mathematical models and engineering analyses are used to describe system performance where applicable.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)Course Description

Quantitative Physiology provides learning opportunities for senior undergraduate and graduate students to understand and develop competencies in a quantitative, research oriented, systems approach to physiology. Systems examined include cellular; musculoskeletal; cardiovascular; respiratory; endocrine; gastrointestinal; and renal. Mathematical models and engineering analyses are used to describe system performance where applicable.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 419 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

Removed biochemistry and organic chemistry as prerequisites to align with the removal of biochemistry and organic chemistry as core curriculum requirements. Any necessary biochemistry content will be introduced in BIOMEDE 221, and thus this course is added as an enforced prerequisite.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-08
Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 451	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 451												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Biomedical Engineering Design	Course Title (full title) Biomedical Engineering Design												
<input type="checkbox"/>	Abbreviated Title (20 char) BME Design, Pt 1	Abbreviated Title (20 char) BME Design, Pt 1												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Two semester course - interdisciplinary groups design-build-test biomedical instrumentation projects. Projects are sponsored by Medical School and Engineering research labs, and local industry. Students are exposed to the entire design process: design, problem definition generation of a design specification, documentation, design review process, prototype fabrication, testing, and calibration.													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: Undergraduate Max: 3 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatabile for Credit Maximum number of repeatable credits:													
<input type="checkbox"/>	<input checked="" type="checkbox"/> Course is Y graded <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 451

<input type="checkbox"/>	Grading Basis <input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration	Add Consent <input checked="" type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input type="checkbox"/> No Consent	Drop Consent <input checked="" type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input type="checkbox"/> No Consent
	Grading <input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only		

	CURRENT LISTING	REQUESTED LISTING
<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BME 458 and senior standing	Advisory Prerequisite (254 char) BIOMEDE 458
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) BIOMEDE 350 and senior standing Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions
<input checked="" type="checkbox"/>	Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input checked="" type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
		Terms Typically Offered <input checked="" type="checkbox"/> Fall <input type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer
Cognizant Faculty Member Name: Rachael Schmedlen		Cognizant Faculty Member Title: Lecturer IV

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen Email: shope@umich.edu Phone: (734) 763-0575

Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair: <i>Rachael Schmedlen</i>	Print: Rachael Schmedlen	Date: 11/11/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Two semester course - interdisciplinary groups design-build-test biomedical instrumentation projects. Projects are sponsored by Medical School and Engineering research labs, and local industry. Students are exposed to the entire design process: design, problem definition generation of a design specification, documentation, design review process, prototype fabrication, testing, and calibration.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)

6

Course Description

Two semester course - interdisciplinary groups design-build-test biomedical instrumentation projects. Projects are sponsored by Medical School and Engineering research labs, and local industry. Students are exposed to the entire design process: design, problem definition generation of a design specification, documentation, design review process, prototype fabrication, testing, and calibration.

Class Length

Full term

Contact hours (lecture):

4

Contact hours (recitation)Contact hours (lab)

6

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

Biomedical engineering undergraduate students are required to complete either BIOMEDE 451 and 452 or BIOMEDE 450.

ABET departmental program outcomes for undergraduate courses:

2, 3, 4, 5, 6, 7

Special resources of facilities required for this course:

Project room in 1150 LBME. The room contains meeting space, storage space, two bioinstrumentation stations, a sink, off-the-shelf supplies for low fidelity prototypes, and basic tools for fabrication. As of Fall 2017, we also have a 3D Fab Lab in 1230 LBME, which contains seven 3D printers, a sewing machine, and workspace.

Supporting statement:

Added BIOMEDE 350 as an enforced prerequisite. BIOMEDE 350 covers portions of the design process and teaches computer-aided drawing and FEA software analysis skills, which are critical skills required for the BIOMEDE 451 capstone design course.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building

500 S. State Street

Ann Arbor, MI 48109-1382

Phone: 734.763.2113

Fax: 734.936.3148

ro.curriculum@umich.edu

ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-07

Effective Term: Fall 2020

<input type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 458	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 458												
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments	<input type="checkbox"/> Course is Cross-Listed with Other Departments												
<input type="checkbox"/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Department</th> <th style="width: 25%;">Subject</th> <th style="width: 50%;">Catalog Number</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Department	Subject	Catalog Number			
Department	Subject	Catalog Number												
Department	Subject	Catalog Number												
<input type="checkbox"/>	Course Title (full title) Biomedical Instrumentation and Design	Course Title (full title) Biomedical Instrumentation and Design												
<input type="checkbox"/>	Abbreviated Title (20 char) Biomed Instru Design	Abbreviated Title (20 char) Biomed Instru Design												
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Biomedical Instrumentation and Design --- Students design and construct functioning biomedical instruments. Hardware includes instrumentation amplifiers and active filters constructed using operational amplifiers. Signal acquisition, processing analysis and display are performed. Project modules include measurement or respiratory volume and flow rates, biopotentials (electrocardiogram), and optical analysis of arterial blood oxygen saturation (pulse-oximetry).													
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: 4 Undergraduate Max: 4 Graduate Max: 4	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:												
<input type="checkbox"/>	Course Credit Type Undergraduate Student, Rackham Graduate Student													
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term													

Subject: Biomedical Engineering Catalog: 458

<input type="checkbox"/>	Grading Basis		
	<input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration	Add Consent <input type="checkbox"/> Department Consent <input checked="" type="checkbox"/> Instructor Consent <input type="checkbox"/> No Consent	Drop Consent <input type="checkbox"/> Department Consent <input checked="" type="checkbox"/> Instructor Consent <input type="checkbox"/> No Consent
	Grading		
	<input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only		

CURRENT LISTING**REQUESTED LISTING**

<input checked="" type="checkbox"/>	Advisory Prerequisite (254 char) BIOMEDE 211/EECS 215/EECS 314/graduate standing	Advisory Prerequisite (254 char)
<input checked="" type="checkbox"/>	Enforced Prerequisite (254 char) [BIOMEDE 211 & 241] or [EECS 215 or 314] or Graduate Standing Minimum grade requirement: C-	Enforced Prerequisite (254 char) BIOMEDE 211 or (EECS 215 or 314) or Graduate Standing Minimum grade requirement: C-
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions

<input type="checkbox"/>	Course Components	Graded Component	Terms Typically Offered
	<input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input checked="" type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer

Cognizant Faculty Member Name: Dennis Claflin

Cognizant Faculty Member Title: Lecturer IV

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachael Schmedlen

Email: shope@umich.edu

Phone: (734) 763-0575

Curriculum Committee Member:

Print:

Date:

Curriculum Committee Chair:

Print:

Date:

Home Department Chair: *Rachael Schmedlen*

Print: Rachael Schmedlen

Date: 11/11/19

Cross-Listed Department Chair:

Print:

Date:

Cross-Listed Department Chair:

Print:

Date:

Cross-Listed Department Chair:

Print:

Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Biomedical Instrumentation and Design --- Students design and construct functioning biomedical instruments. Hardware includes instrumentation amplifiers and active filters constructed using operational amplifiers. Signal acquisition, processing analysis and display are performed. Project modules include measurement or respiratory volume and flow rates, biopotentials (electrocardiogram), and optical analysis of arterial blood oxygen saturation (pulse-oximetry).

Course Description

Biomedical Instrumentation and Design --- Students design and construct functioning biomedical instruments. Hardware includes instrumentation amplifiers and active filters constructed using operational amplifiers. Signal acquisition, processing analysis and display are performed. Project modules include measurement or respiratory volume and flow rates, biopotentials (electrocardiogram), and optical analysis of arterial blood oxygen saturation (pulse-oximetry).

Class Length

Full term

Class Length

Full term

Contact hours (lecture):

1

Contact hours (lecture):

1

Contact hours (recitation)Contact hours (recitation)Contact hours (lab)

3

Contact hours (lab)

3

Additional Info:Submitted by:

Home dept

Describe how this course fits with the degree requirements:

BIOMEDE 458 is a required course for all students in the biomedical engineering undergraduate program.

ABET departmental program outcomes for undergraduate courses:

3, 5, 6, 7

Special resources of facilities required for this course:Supporting statement:

Removed BIOMEDE 241 as a prerequisite to reflect that BIOMEDE 241 no longer includes circuit modules to prepare students for BIOMEDE 458. These modules will now be included in the BIOMEDE 211 course, which remains an enforced prerequisite for BIOMEDE 458.

Minimum Grade Policy for IB Credit in Degree Audit

Summary: Kristel Briney, Student Academic Success Coordinator for MECHENG, was interested in beginning a conversation after she found a student that received a "D-" grade for his Intellectual Breadth (three 300+ level HU/LAC credits) credit. She mentioned that ME requires a "D" for IB credit and wanted this to be reflected in his Degree Audit Report.

Michael Shearon, from the University RO, responded with:

The Intellectual Breadth requirement in the degree audit is coded as a college-wide requirement that applies to not only MechEng students, but all UENG students. Currently the HU/LAC/PCDC portion of the requirement accepts any passing grade (D- or higher). As far as I can tell, the degree audit has been coded to accept any passing grade for quite some time.

MechEng has indicated that the passing grade for HU/LAC/PCDC should actually be a D (not a D-) and would like the audit to reflect this understanding of the policy for its students. However, simply modifying the existing HU/LAC/PCDC requirement to require a higher grade will impact all UENG students, not only MechEng students.

Also, changing the audit coding so that each department can specify its own policy regarding minimum HU/LAC/PCDC grade for its students represent some significant changes in the back-end coding of the audit.

So, addressing the issue is a much bigger deal than it appears on the surface. We need to have a firm and clear understanding of what the college's policy is regarding this requirement before possibly undertaking any work.

What is the college's policy regarding Intellectual Breadth courses and minimum grades? Is there a college-wide policy regarding minimum grades for HU/LAC/PCDC, or does each department get to decide what grade they will accept? If so, what is the minimum grade required for each program?

Betsy Dodge provides the NCAA Attestations and had to discuss with all departments regarding their grade requirements for IB credit. Mostly, they are a D-, but ME is a D, AERO is a D, BME is a C- and EECS a C-.

Modifications to CARF Form

- New signature line added for Curriculum Committee Member.
- New instructions added requesting both printed name and signature.
- New "Print" section added to signature lines for printed name.

<input checked="" type="checkbox"/>	Course Components <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Recitation <input type="checkbox"/> Lab <input type="checkbox"/> Discussion <input type="checkbox"/> Independent Study	Graded Component <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Terms Typically Offered <input type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Spring/Summer
Cognizant Faculty Member Name: Mark VanOyen		Cognizant Faculty Member Title:	

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person:	Email:	Phone:
Curriculum Committee Member:	Print:	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

College of Engineering Curriculum Committee Member Guide

Useful First Steps

- Find out who the relevant staff member is in your department - Every department has a staff member that prepares materials for the CoE Curriculum Committee (CC). Introduce yourself to that person, and ask them to run all materials that are going to the committee past you, so you are familiar with them and can speak to them at committee meetings. If you are not sure who that staff member is, check with Betsy Dodge or Joshua Wirgau, administrative support for the committee, reachable at engineering-ro@umich.edu, the CoE registrar's office email.
- Familiarize yourself with the rules and policies. a) The official duties and powers of the CoE CC are found in the [CoE Faculty Rules](#) in sections VI and VII.B. Changes in these rules must go through the CoE Rules Committee according to the procedures in these rules. b) Procedures that have been adopted by the Committee can be found at this [site](#). They include policies for course-related requests and for non-course-related requests. You'll want to read these documents and become acquainted with policies, as you are the go-to person in your department

CC Member Expectations

Members should try to review the business on the meeting agenda prior to the meeting. In particular:

- You should be familiar with any request(s)/change(s) related to your academic unit and be prepared to present them during the committee meeting. You should be ready to approve or reject minor changes in course approval forms (CARFs) that may arise during the CC discussion. (CARFs are typically prepared and submitted by the staff member in your academic unit. You and the staff member, working together, must ensure that the CARFs are submitted to the CC by the deadline.) If the committee raises issues that cannot be resolved in a meeting, at the direction of the CC Chair, you should take the concerns back to your unit and attempt to resolve the issues for resubmission to the committee.
- If your academic unit is submitting one or more CARFs, program changes, or other business, and you cannot attend the meeting, then you and/or your unit

should arrange for a representative to attend. The representative should be familiar with the CARFs and proposed changes.

- When your academic unit submits CARFs or other business to the CC, you should be notified in advance. It is advisable for units to consult with you prior to submitting such materials or any requests.
- You should also be prepared to address issues as to how a proposed change by another academic unit might affect your degree programs and its students.
- You should be well familiar with the degree program requirements (both graduate and undergraduate) in your academic unit. Members should also be well familiar with the academic rules of the CoE and Rackham, although it is inevitable that such knowledge grows with service time on the Committee.
- There is an issue as to whether or not the CC members should be aware of ABET (accreditation body) implications of proposed changes submitted to the committee. Since the CoE is the body charged with approving course and program changes, perhaps some consideration should be retained even with the ABET groups active in the CoE. It would seem reasonable that CC members should have some familiarity with their program's ABET process and requirements.
- For any item reviewed at a CC meeting that is to be addressed subsequently at a CoE Faculty Meeting, that item's key constituent(s) must be informed of all final decisions related to that item immediately following the CC vote, such as who will be presenting it at the Faculty Meeting, what slides will be used, when the slides are to be submitted, etc.
- There are various deadlines involved in submitting proposals to the CoE CC and making course/curricular changes. Some of these deadlines are internal to the CoE while others are driven by the central campus registrar's office. Also, the deadlines may change based on whether the proposed prerequisites in the CARF are to be "enforced" or not. One of your key responsibilities is to be aware of these deadlines and ensure that they are communicated to your colleagues in your academic unit. Otherwise, changes planned by your academic unit may not be implemented in time even if they are approved by the CoE CC.

CC Guiding Principles

- In most cases, the CC does not question the academic merit of the proposed course and curriculum changes. This is principally the responsibility and domain of the academic units; however, questions may be asked by Committee members in this area to ensure that these issues have been carefully considered and appropriately documented by the academic unit. In some cases, the questions or concerns raised by the Committee members are related to missing or ambiguous information in the CARFs and related documents.
- Similarly, questions may be asked as to how the proposed course and curriculum changes will affect accreditation (both ABET and HLC).
- In most cases, the examination of the proposed changes by the CC will be centered on clarity (such as course descriptions, prerequisites, etc.), whether or not there are unintended consequences, and the impact of the proposed changes on students (such as time to graduation, plans for current students when a new program is introduced, etc.).



Course Approval Request Form
Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
- Modification of Existing Course
- Deletion of Existing Course

Date of Submission: 2019-11-06
Effective Term: Fall 2020

<input checked="" type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input checked="" type="checkbox"/>	Dept (Home): Material Science Engineering			Dept (Home): Material Science Engineering		
	Subject: MATSCIE			Subject: MATSCIE		
	Catalog: 480			Catalog: 482		
	<input type="checkbox"/> Course is Cross-Listed with Other Departments			<input type="checkbox"/> Course is Cross-Listed with Other Departments		
<input type="checkbox"/>	Department	Subject	Catalog Number	Department	Subject	Catalog Number
<input checked="" type="checkbox"/>	Course Title (full title) Materials and Engineering Design			Course Title (full title) Product Design and Manufacturing		
<input checked="" type="checkbox"/>	Abbreviated Title (20 char) MAT ENG DES			Abbreviated Title (20 char) Prod. Design Man.		
<input checked="" type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Design, manufacturing and validation of complex products. Sponsor-based projects. Project based teamwork. Prototyping. User centric design principles. System engineering. Project management. Written and oral presentations at design reviews.					
<input checked="" type="checkbox"/>	Full Term Credit Hours			Half Term Credit Hours		
	Undergraduate Min: 3	Graduate Min: 3		Undergraduate Min:	Graduate Min:	
	Undergraduate Max: 3	Graduate Max: 3		Undergraduate Max:	Graduate Max:	
<input checked="" type="checkbox"/>	Course Credit Type Undergraduate Student, Rackham Graduate Student					
<input type="checkbox"/>	Repeatability					
	<input type="checkbox"/> Course is Repeatable for Credit			<input type="checkbox"/> Course is Y graded		
	Maximum number of repeatable credits:			<input type="checkbox"/> Can be taken more than once in the same term		

Subject: Material Science Engineering Catalog: 480

<input checked="" type="checkbox"/>	Grading Basis	<input checked="" type="checkbox"/> Graded (A – E)	Add Consent	Drop Consent
	<input type="checkbox"/> Credit/No Credit	<input type="checkbox"/> Satisfactory/Unsatisfactory		
	<input type="checkbox"/> Pass/Fail	<input type="checkbox"/> Business Administration	<input type="checkbox"/> Instructor Consent	<input type="checkbox"/> Instructor Consent
	Grading	<input type="checkbox"/> Not for Credit	<input checked="" type="checkbox"/> No Consent	<input checked="" type="checkbox"/> No Consent
	<input type="checkbox"/> Not for Degree Credit			
	<input type="checkbox"/> Degree Credit Only			

CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)																					
<input type="checkbox"/>	Enforced Prerequisite (254 char) Senior Standing Minimum grade requirement: C-	Enforced Prerequisite (254 char) Senior Standing Minimum grade requirement: C-																					
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions																					
<input checked="" type="checkbox"/>	<table border="0"> <tr> <td>Course Components</td> <td>Graded Component</td> <td>Terms Typically Offered</td> </tr> <tr> <td><input checked="" type="checkbox"/> Lecture</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/> Fall</td> </tr> <tr> <td><input type="checkbox"/> Seminar</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> Winter</td> </tr> <tr> <td><input type="checkbox"/> Recitation</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/> Spring</td> </tr> <tr> <td><input type="checkbox"/> Lab</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/> Summer</td> </tr> <tr> <td><input type="checkbox"/> Discussion</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/> Spring/Summer</td> </tr> <tr> <td><input type="checkbox"/> Independent Study</td> <td><input type="checkbox"/></td> <td></td> </tr> </table>	Course Components	Graded Component	Terms Typically Offered	<input checked="" type="checkbox"/> Lecture	<input checked="" type="checkbox"/>	<input type="checkbox"/> Fall	<input type="checkbox"/> Seminar	<input type="checkbox"/>	<input checked="" type="checkbox"/> Winter	<input type="checkbox"/> Recitation	<input type="checkbox"/>	<input type="checkbox"/> Spring	<input type="checkbox"/> Lab	<input type="checkbox"/>	<input type="checkbox"/> Summer	<input type="checkbox"/> Discussion	<input type="checkbox"/>	<input type="checkbox"/> Spring/Summer	<input type="checkbox"/> Independent Study	<input type="checkbox"/>		
Course Components	Graded Component	Terms Typically Offered																					
<input checked="" type="checkbox"/> Lecture	<input checked="" type="checkbox"/>	<input type="checkbox"/> Fall																					
<input type="checkbox"/> Seminar	<input type="checkbox"/>	<input checked="" type="checkbox"/> Winter																					
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<input type="checkbox"/> Discussion	<input type="checkbox"/>	<input type="checkbox"/> Spring/Summer																					
<input type="checkbox"/> Independent Study	<input type="checkbox"/>																						
Cognizant Faculty Member Name: Alan Taub		Cognizant Faculty Member Title:																					

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: *Emmanuelle* Email: *Emarg*
marquis

Phone:

Curriculum Committee Member:



Print: *Emmanuelle Marquis* Date: *11-6-19*

Curriculum Committee Chair:

Print: _____ Date: _____

Home Department Chair:



Print: *Amit Misra* Date: *11/8/19*

Cross-Listed Department Chair:

Print: _____ Date: _____

Cross-Listed Department Chair:

Print: _____ Date: _____

Cross-Listed Department Chair:

Print: _____ Date: _____

DEPARTMENTAL/COLLEGE USE ONLY

Current:Course Description

Design concepts. Engineering economics. Various design criteria, processes, and process control. Materials substitution. Competitive design. Case histories. Professional and ethical considerations. Written and oral presentations of solutions to design problems.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)**Requested:**Course Description

Design, manufacturing and validation of complex products. Sponsor-based projects. Project based teamwork. Prototyping. User centric design principles. System engineering. Project management. Written and oral presentations at design reviews.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

Degree Requirement

ABET departmental program outcomes for undergraduate courses:

2,3,4

Special resources of facilities required for this course:

The students will need the use of laboratory and computer facilities for design information. Most needs will be met by CAEN and department facilities. Students will have to seek off-campus resources to solve some of their problems.

Supporting statement:

This form is being submitted at this time to update the course description.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building

500 S. State Street

Ann Arbor, MI 48109-1382

Phone: 734.763.2113

Fax: 734.936.3148

ro.curriculum@umich.edu

ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-04

Effective Term: Fall 2020

<input checked="" type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING


<input checked="" type="checkbox"/>	Dept (Home): Material Science Engineering			Dept (Home): Material Science Engineering		
	Subject: MATSCIE			Subject: MATSCIE		
	Catalog: 489			Catalog: 481		
	<input type="checkbox"/> Course is Cross-Listed with Other Departments			<input type="checkbox"/> Course is Cross-Listed with Other Departments		
<input type="checkbox"/>	Department	Subject	Catalog Number	Department	Subject	Catalog Number
<input checked="" type="checkbox"/>	Course Title (full title) Materials Processing Design			Course Title (full title) Designing Sustainable Products and Processes		
<input checked="" type="checkbox"/>	Abbreviated Title (20 char) MTLS Proc Design			Abbreviated Title (20 char) Design Sustain Prod.		
<input checked="" type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Projects based on environmental sustainability. Project based teamwork. Life Cycle Analysis (LCA). Techno-Economic Analysis (TEA). Engineering economics. Environmental impact with emphasis on CO2 utilization. Identification of key technology drivers to reduce cost and environmental impact. Written and oral presentations of solutions.					
<input checked="" type="checkbox"/>	Full Term Credit Hours			Half Term Credit Hours		
	Undergraduate Min: 3	Graduate Min: 3		Undergraduate Min:	Graduate Min:	
	Undergraduate Max: 3	Graduate Max: 3		Undergraduate Max:	Graduate Max:	
<input checked="" type="checkbox"/>	Course Credit Type Undergraduate Student, Rackham Graduate Student					
<input type="checkbox"/>	Repeatability					
	<input type="checkbox"/> Course is Repeatable for Credit			<input type="checkbox"/> Course is Y graded		
	Maximum number of repeatable credits:			<input type="checkbox"/> Can be taken more than once in the same term		

Subject: Material Science Engineering Catalog: 489	
<input checked="" type="checkbox"/>	Grading Basis <input checked="" type="checkbox"/> Graded (A – E) <input type="checkbox"/> Credit/No Credit <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> Pass/Fail <input type="checkbox"/> Business Administration Grading <input type="checkbox"/> Not for Credit <input type="checkbox"/> Not for Degree Credit <input type="checkbox"/> Degree Credit Only
	Add Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent
	Drop Consent <input type="checkbox"/> Department Consent <input type="checkbox"/> Instructor Consent <input checked="" type="checkbox"/> No Consent

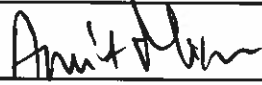
CURRENT LISTING	REQUESTED LISTING																					
<input type="checkbox"/> Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)																					
<input type="checkbox"/> Enforced Prerequisite (254 char) Senior Standing Minimum grade requirement: C-	Enforced Prerequisite (254 char) Senior Standing Minimum grade requirement: C-																					
<input type="checkbox"/> Credit Exclusions	Credit Exclusions																					
<table style="width: 100%; border: none;"> <tr> <td style="width: 33%; border: none;">Course Components</td> <td style="width: 33%; border: none;">Graded Component</td> <td style="width: 34%; border: none;">Terms Typically Offered</td> </tr> <tr> <td style="border: none;"><input checked="" type="checkbox"/> Lecture</td> <td style="border: none;"><input checked="" type="checkbox"/></td> <td style="border: none;"><input checked="" type="checkbox"/> Fall</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Seminar</td> <td style="border: none;"><input type="checkbox"/></td> <td style="border: none;"><input type="checkbox"/> Winter</td> </tr> <tr> <td style="border: none;"><input checked="" type="checkbox"/> Recitation</td> <td style="border: none;"><input type="checkbox"/></td> <td style="border: none;"><input type="checkbox"/> Spring</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Lab</td> <td style="border: none;"><input type="checkbox"/></td> <td style="border: none;"><input type="checkbox"/> Summer</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Discussion</td> <td style="border: none;"><input type="checkbox"/></td> <td style="border: none;"><input type="checkbox"/> Spring/Summer</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Independent Study</td> <td style="border: none;"><input type="checkbox"/></td> <td></td> </tr> </table>	Course Components	Graded Component	Terms Typically Offered	<input checked="" type="checkbox"/> Lecture	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fall	<input type="checkbox"/> Seminar	<input type="checkbox"/>	<input type="checkbox"/> Winter	<input checked="" type="checkbox"/> Recitation	<input type="checkbox"/>	<input type="checkbox"/> Spring	<input type="checkbox"/> Lab	<input type="checkbox"/>	<input type="checkbox"/> Summer	<input type="checkbox"/> Discussion	<input type="checkbox"/>	<input type="checkbox"/> Spring/Summer	<input type="checkbox"/> Independent Study	<input type="checkbox"/>		
Course Components	Graded Component	Terms Typically Offered																				
<input checked="" type="checkbox"/> Lecture	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fall																				
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<input type="checkbox"/> Independent Study	<input type="checkbox"/>																					
Cognizant Faculty Member Name: Alan Taub	Cognizant Faculty Member Title:																					

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Emmanuelle Marguis Email: emarg@marquis Phone: _____

Curriculum Committee Member:  Print: Emmanuelle Marguis Date: 11-6-19

Curriculum Committee Chair: _____ Print: _____ Date: _____

Home Department Chair:  Print: Amit Misra Date: 11/8/19

Cross-Listed Department Chair: _____ Print: _____ Date: _____

Cross-Listed Department Chair: _____ Print: _____ Date: _____

Cross-Listed Department Chair: _____ Print: _____ Date: _____

DEPARTMENTAL/COLLEGE USE ONLY

Current:Course Description

The design and production of engineering materials. Design problems such as: extraction and refining methods, or production and processing of ceramics, polymeric, or electronic materials. Written and oral presentations of solutions to processing design problems.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)**Requested:**Course Description

Projects based on environmental sustainability. Project based teamwork. Life Cycle Analysis (LCA). Techno-Economic Analysis (TEA). Engineering economics. Environmental impact with emphasis on CO2 utilization. Identification of key technology drivers to reduce cost and environmental impact. Written and oral presentations of solutions.

Class Length

Full term

Contact hours (lecture):

3

Contact hours (recitation)Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

Degree Requirement

ABET departmental program outcomes for undergraduate courses:

2,3,5

Special resources of facilities required for this course:Supporting statement:

This form is being submitted at this time to update the course description.



Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested

- New Course
 Modification of Existing Course
 Deletion of Existing Course

Date of Submission: 2019-11-01
Effective Term: Winter 2020

<input checked="" type="checkbox"/>	Course Offered <input checked="" type="checkbox"/> Indefinitely <input type="checkbox"/> One term only	RO USE ONLY Date Received: Date Completed: Completed By:
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CURRENT LISTING

REQUESTED LISTING

<input type="checkbox"/>	Dept (Home): Civil & Environmental Engin Subject: CEE Catalog: 431			Dept (Home): Subject: Catalog:		
<input type="checkbox"/>	<input type="checkbox"/> Course is Cross-Listed with Other Departments			<input type="checkbox"/> Course is Cross-Listed with Other Departments		
<input type="checkbox"/>	Department	Subject	Catalog Number	Department	Subject	Catalog Number
<input type="checkbox"/>	Course Title (full title) Construction Contracting			Course Title (full title)		
<input type="checkbox"/>	Abbreviated Title (20 char) Constr Contracting			Abbreviated Title (20 char)		
<input type="checkbox"/>	Course Description (Please limit to 50 words and attach separate sheet if necessary) Construction contracting for engineers, contractors, architects, owners. (1) Organization and administration; industry structure; construction contracts, bonds, insurance, dispute resolution. (2) Planning, estimating, and control; quantity takeoff and pricing; labor and equipment estimates; estimating excavation and concrete; proposal preparation; scheduling; accounting and cost control. Students use contract documents to prepare detailed estimate.					
<input type="checkbox"/>	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: 4 Undergraduate Max: 4 Graduate Max: 4			Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:		
<input type="checkbox"/>	Course Credit Type Undergraduate Student, Rackham Graduate Student, Non-Rackham Graduate Student, Rackham Graduate Student with Additional Work					
<input type="checkbox"/>	Repeatability <input type="checkbox"/> Course is Repeatable for Credit <input type="checkbox"/> Course is Y graded Maximum number of repeatable credits: <input type="checkbox"/> Can be taken more than once in the same term					

Subject: Civil & Environmental Engin		Catalog: 431	
<input type="checkbox"/>	Grading Basis		
	<input checked="" type="checkbox"/> Graded (A – E)		
	<input type="checkbox"/> Credit/No Credit		
	<input type="checkbox"/> Satisfactory/Unsatisfactory	Add Consent	Drop Consent
	<input type="checkbox"/> Pass/Fail	<input type="checkbox"/> Department Consent	<input type="checkbox"/> Department Consent
<input type="checkbox"/> Business Administration	<input type="checkbox"/> Instructor Consent	<input type="checkbox"/> Instructor Consent	
<input type="checkbox"/> Grading	<input checked="" type="checkbox"/> No Consent	<input checked="" type="checkbox"/> No Consent	
<input type="checkbox"/> Not for Credit			
<input type="checkbox"/> Not for Degree Credit			
<input type="checkbox"/> Degree Credit Only			

CURRENT LISTING		REQUESTED LISTING	
<input type="checkbox"/>	Advisory Prerequisite (254 char) Senior Standing	Advisory Prerequisite (254 char)	
<input type="checkbox"/>	Enforced Prerequisite (254 char)	Enforced Prerequisite (254 char)	
<input type="checkbox"/>	Minimum grade requirement:	Minimum grade requirement:	
<input type="checkbox"/>	Credit Exclusions	Credit Exclusions	
<input type="checkbox"/>	Course Components	Graded Component	Terms Typically Offered
	<input checked="" type="checkbox"/> Lecture	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fall
	<input type="checkbox"/> Seminar	<input type="checkbox"/>	<input type="checkbox"/> Winter
	<input type="checkbox"/> Recitation	<input type="checkbox"/>	<input type="checkbox"/> Spring
	<input checked="" type="checkbox"/> Lab	<input type="checkbox"/>	<input type="checkbox"/> Summer
	<input type="checkbox"/> Discussion	<input type="checkbox"/>	<input type="checkbox"/> Spring/Summer
	<input type="checkbox"/> Independent Study	<input type="checkbox"/>	
Cognizant Faculty Member Name: Carol Menassa		Cognizant Faculty Member Title: Associate Professor	

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Susan
Kaiser

Email: smkaiser@umich.edu

Phone: 764-4106

Curriculum Committee Member:	Print: Christian Lastoskie, Associate Professor	Date:
Curriculum Committee Chair:	Print:	Date:
Home Department Chair:	Print: Jerome Lynch, Professor	Date: 11/4/19
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:
Cross-Listed Department Chair:	Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:**Requested:**Course Description

Construction contracting for engineers, contractors, architects, owners. (1) Organization and administration; industry structure; construction contracts, bonds, insurance, dispute resolution. (2) Planning, estimating, and control; quantity takeoff and pricing; labor and equipment estimates; estimating excavation and concrete; proposal preparation; scheduling; accounting and cost control. Students use contract documents to prepare detailed estimate.

Course DescriptionClass Length

Full term

Class LengthContact hours (lecture):

3

Contact hours (lecture):Contact hours (recitation)Contact hours (recitation)Contact hours (lab)

1

Contact hours (lab)**Additional Info:**Submitted by:

Home dept

Describe how this course fits with the degree requirements:

Program elective for the BSE in Civil Engineering.

ABET departmental program outcomes for undergraduate courses:

1

Special resources of facilities required for this course:Supporting statement:

This course has been renamed CEE 331. We are deleting previous course number per request of the registrar.