

**Co-Terminal Degree Proposal**  
**Bachelor of Science in Chemical Engineering**  
**Master of Biomedical Engineering**

**Undergraduate Program**

Undergraduate Program Type: Bachelor of Science in Chemical Engineering

Total Undergraduate Program Credit Hours (including shared credit): 132-133 hours

Program Description: Chemical engineering is concerned with the design, development, and management of facilities that convert raw materials into useful products. The engineer must assume responsibility for the economical use of the raw materials, preservation of the environment, and profitability of the operation. The chemical engineering program has been designed to provide both the engineering competence and the professional skills necessary to succeed in this endeavor. In order to achieve this objective, the curriculum incorporates coursework in both of these areas throughout the four-year duration of the program.

Program Purpose: The co-terminal program between the BS in Chemical Engineering and Master of Biomedical Engineering will provide students the opportunity to gain additional knowledge in biomedical science and engineering and to apply and integrate traditional chemical engineering principles and tools towards a better understanding of physiological processes in humans or towards the solution of medical problems.

Program Benefits: Principles from traditional engineering disciplines, such as chemical engineering, are frequently applied to solve biomedical engineering problems that play an increasingly important role in advancing medical treatment, developing biotechnology, and improving healthcare delivery. By offering this co-terminal program we are providing chemical engineering undergraduate students the opportunity to apply and expand their foundational knowledge towards the solution of biomedical problems at the microscopic level including but not limited to the engineering of artificial tissues, development of drug delivery vehicles and biomaterials for implantation. This co-terminal degree will provide undergraduate chemical engineering students with a path of greater competitiveness in industry, graduate school, or professional programs while they retain undergraduate financial aid benefits.

Course requirements and sample curriculum: Course requirements and a sample curriculum are included in this document.

Competitive Programs: BS CHE is a competitive degree offered by many institutions. However, most schools do not offer a co-terminal BS CHE and MAS in BME.

Market Analysis: BS CHE is a competitive degree offered by many institutions. Please refer to the market analysis for the Master of Biomedical Engineering degree.

Marketing and Advertising: Both degrees are currently marketed. The co-terminal degree will be included in current co-terminal degree marketing and additional marketing by the Armour College of Engineering.

Enrollment Estimates: Estimated enrollment in this co-terminal program is approximately 5-10 new students/year.

Retention Estimates: It is anticipated that retention may be improved for transfer students as the co-terminal program allows more flexibility for scheduling each semester.

Economic Analysis: There are no additional costs for the co-terminal program. It is expected that this co-terminal program will draw from a group of students separate from those who pursue the other CHE co-terminal programs (MAS Biological Engineering, MAS Chemical Engineering, MAS Food Process Engineering, ME Environmental Engineering ). Therefore, it is expected that additional tuition revenue will be generated equivalent to 21 credits/student enrolled in the program.

## **Graduate Program**

Graduate Program: Master of Biomedical Engineering

Program Overview: The overall objective of the Master of Engineering in Biomedical Engineering degree is to provide training relevant to professional employment in a biomedical engineering related field.

Program Justification: The Armour College of Engineering is committed to be a lifelong educational partner with our community, from pre-college to professional advancement. The Masters degree program in Biomedical Engineering contributes to this commitment by enhancing the overall offerings within the Armour College of Engineering.

Program Resources: The co-terminal program does not require additional resources. The Masters in Biomedical Engineering curriculum includes existing courses. The co-terminal program requires 5 graduate courses as core: BME 500, BME 553, BME 533, BME 524, CHE 580. Please refer to course list below.

Program description: A detailed list of courses required for the co-terminal degree is provided. Students should have an undergraduate minimum 3.0 GPA in order to be accepted into the co-terminal program. Students will be accepted into the program beginning Fall 2018.

Description of courses shared between Undergraduate and Graduate programs:

Shared required courses:

UG:	CHE 406	as GRAD:	Engineering Elective
UG:	CHE 423	as GRAD:	Engineering Elective
UG:	CHE 435	as GRAD:	Engineering Elective

## Bachelor of Science in Chemical Engineering/Master of Biomedical Engineering

Required Courses	Credit Hours		
	UG	grad	total
<b>Chemical Engineering Core Requirements</b> <i>CHE 100, 101, 202, 239, 301, 302, 311, 317, 351, <b>406</b>,<sup>a</sup> 418, <b>423</b>,<sup>a</sup> 433, <b>435</b>,<sup>a</sup> 451, 494, 496</i>	47	9	47
<b>Master of Biomedical Engineering Core Requirements</b> <i>BME 500, BME 524, BME 533, BME 553, CHE 580</i>	0	15	15
<b>Master of Biomedical Engineering Electives</b> <i>500 level Engineering Electives OR Special Projects<sup>b</sup></i>	0	6	6
<b>Science Requirements</b> <i>CHEM 125, CHEM 237, CHEM 239, CHEM 343, PHYS 123, PHYS 221, BIOL 403<sup>c</sup></i>	26	0	26
<b>Electrical and Computer Engineering Requirements</b> <i>ECE 211 or 218</i>	3-4	0	3-4
<b>Mathematics &amp; Computer Science Requirements</b> <i>MATH 151, MATH 152, MATH 251, MATH 252, CS 104 or CS 105</i>	20	0	20
<b>Technical Electives</b> <i>One technical elective must be CHE 426 or an engineering science elective (CHE 400+ level)</i>	9	0	9
<b>Humanities and Social Science Requirements</b>	21	0	21
<b>IPRO</b>	6	0	6
<b>Total</b>	132-133	30	153-154
(132-133 BME UG) + 30 (Masters of BME) -9 (shared credits) = 153-154 (total)			

<sup>a</sup> shared courses between undergraduate and graduate curricula (9 cr)

<sup>b</sup> should be a CHE or BME special projects course

<sup>c</sup> BIOL 403 is a required course in the CHE UG curriculum for this co-terminal program.

### Sample Schedule:

Semester 1	Credits	Semester 2	Credits
CHE 100	2	CHE 101	2
MATH 151	5	MATH 152	5
CHEM 125 <sup>1</sup>	4	PHYS 123	4
CS 104 or 105	2	Social Science Elective	3
Humanities 200-level course	3	Humanities or Social Science Elective	3
<b>Total</b>	<b>16</b>	<b>Total</b>	<b>17</b>
Semester 3	Credits	Semester 4	Credits
CHE 202	3	CHE 239	3
MATH 252 Introduction to Differential Equations	4	CHE 301	3
CHEM 237	4	MATH 251	4
PHYS 221	4	CHEM 239	3
Hum Elective (300+)	3	CHEM 343	3
<b>Total</b>	<b>18</b>	<b>Total</b>	<b>16</b>
Semester 5	Credits	Semester 6	Credits
CHE 302	3	CHE 317	2
CHE 311	3	CHE 433	3
CHE 351	3	CHE 451	3
ECE 211 or 218	3-4	BIOL 403 <sup>2</sup>	4
Humanities Elective (300+)	3	IPRO I	3
<b>Total</b>	<b>15-16</b>	<b>Total</b>	<b>15</b>
Semester 7		Semester 8	
CHE 418	2	CHE 406	3
CHE 423	3	CHE 496	3
CHE 435	3	IPRO II	3
CHE 494	3	Technical Elective <sup>3</sup>	3
Technical Elective <sup>3</sup>	3	Social Science Elective (300+)	3
<b>Total</b>	<b>14</b>	<b>Total</b>	<b>15</b>
Semester 9		Semester 10	
BME 533 Applications of Statistics	3	BME 500 level Elective	3
CHE 580 Biomaterials	3	BME 524 Quant Aspects of Cell & Tissue Eng	3
BME 500 Intro to BME	3	BME 553 Quantitative Physiology	3
BME 500 level Elective	3	Engineering Elective or Special Project <sup>4</sup>	3
Social Science Elective (300+)	3	Technical Elective <sup>3</sup>	3
<b>Total</b>	<b>15</b>	<b>Total</b>	<b>15</b>

Shared Credits (9 credit hours): CHE 406, CHE 423, CHE 435

<sup>1</sup> Initial placement in CHEM 125 requires the consent of the chemistry department

<sup>2</sup> BIOL 403 is required for this co-terminal program

<sup>3</sup> One technical elective must be CHE 426 or an engineering science elective (CHE 400+ level)

<sup>4</sup> Engineering Elective OR Special Projects course should be a 500-level course. Special Projects course should be CHE or BME.