

# Chemical Engineering

## 1. University Requirements: (23)

Writing, Rhetoric and American Cultures (WRA)	4
Integrative Studies in Humanities (IAH)	8
IAH 201-210 and IAH 211 or >	
Integrative Studies in Social Sciences (ISS)	8
ISS 2XX and ISS 3XX	
Bioscience: BS 161 Cell and Molecular Biology	3

## 2. College Requirements: (30)

*CEM 151 General and Descriptive Chemistry	4
*EGR 100 Introduction to Engineering Design	2
*EGR 102 Introduction to Engineering Modeling	2
*MTH 132 Calculus I	3
*MTH 133 Calculus II	4
MTH 234 Multivariable Calculus	4
MTH 235 Differential Equations	3
*PHY 183 Physics for Scientists & Engineers I	4
PHY 184 Physics for Scientists & Engineers II	4
* College Admission Requirement	

## 3. Major Requirements: (67-69)

### a. Complete all of the following courses: (51)

CEM 152 Principles of Chemistry	3
CEM 161 Chemistry Laboratory I	1
CEM 162 Chemistry Laboratory II	1
CEM 351 Organic Chemistry I	3
CEM 352 Organic Chemistry II	3
CEM 355 Organic Laboratory I	2
CHE 201 Material and Energy Balances	3
CHE 210 Modeling and Analysis of Transport Phenomena	3
CHE 301 Chemical Engineering as a Profession	1
CHE 311 Fluid Flow and Heat Transfer	3
CHE 312 Mass Transfer and Separations	4
CHE 316 Lab Practice and Statistical Analysis (W)	4
CHE 321 Thermodynamics for Chemical Engineering	4
CHE 431 Chemical Reaction Engineering	4
CHE 432 Process Analysis and Control	3
CHE 433 Process Design and Optimization I (W)	4
CHE 434 Process Design and Optimization II	2
CHE 473 Chemical Engineering Principles in Polymers & Materials Systems	3

### b. One of the following groups: (4-6)

#### Group 1

BMB 401 Comprehensive Biochemistry	4
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#### Group 2

BMB 461 Advanced Biochemistry I	3
BMB 462 Advanced Biochemistry II	3

Note: If BMB 462 is taken to fulfill requirement 3. b., it will also count as a technical elective in item 3. e.

### c. Select one of the following courses: (3)

CHE 472 Composite Materials Processing	3
CHE 481 Biochemical Engineering	3

### d. Select one of the following courses: (3)

CEM 483 Quantum Chemistry	3
CEM 484 Molecular Thermodynamics	3

## e. Technical Electives: (6)

Students must complete at least 6 credits in courses selected from a list of approved technical electives available from the Department of Chemical Engineering and Materials Science.

## Concentrations in Chemical Engineering

In response to increasing interest in the application of chemical engineering principles to related fields, the Department of Chemical Engineering and Materials Science offers concentrations in biochemical engineering, bioenergy, biomedical engineering, environmental engineering, food science, and polymer science and engineering to students wishing an area of concentration in the degree. Concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree program in Chemical Engineering. The concentration will be noted on the student's transcript.

*NOTE: Completing the Bachelor of Science degree in Chemical Engineering with a concentration may require more than 128 credits. For any concentration, up to 3 credits of Independent Study (CHE 490) related to the subject area may be applied with approval of the Department of Chemical Engineering and Materials Science.*

## Biochemical Engineering Concentration: (18-21)

To earn a Bachelor of Science degree in Chemical Engineering with a biochemical engineering concentration, students must complete requirements 1., 2., 3.a., and 3.d., above and the following:

### All of the following courses: (6)

CHE 481 Biochemical Engineering	3
MMG 301 Introductory Microbiology	3

### One of the following tracks: (11-13)

#### Track 1 (12-13 credits)

#### The following course: (4)

BMB 401 Comprehensive Biochemistry	3
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### Three of the following courses: (8-9 credits)

BMB 805 Protein Structure, Design, and Mechanism	3
BMB 829 Methods of Macromolecular Analysis and Synthesis	2
CHE 882 Advanced Biochemical Engineering	3
CHE 883 Multidisciplinary Bioprocessing Laboratory	3
MMG 409 Eukaryotic Cell Biology	3
MMG 421 Prokaryotic Cell Physiology	3
MMG 431 Microbial Genetics	3

**Biochemical Engineering Concentration Continued:**

***Track 2 (11-12 credits)***

**Both of the following courses: (6)**

BMB 461	Advanced Biochemistry I	3
BMB 462	Advanced Biochemistry II	3

**Two of the following courses: (5-6 credits)**

BMB 805	Protein Structure, Design, and Mechanism	3
BMB 829	Methods of Macromolecular Analysis & Synthesis	2
CHE 882	Advanced Biochemical Engineering	3
CHE 883	Multidisciplinary Bioprocessing Laboratory	3
MMG 409	Eukaryotic Cell Biology	3
MMG 421	Prokaryotic Cell Physiology	3
MMG 431	Microbial Genetics	3

**Bioenergy and Bioproducts Concentration: (15)**

To earn a Bachelor of Science degree in Chemical Engineering with a bioenergy and bioproducts concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d., above and the following:

**All of the following courses: (9)**

CHE 468	Biomass Conversion in Engineering	3
CHE 481	Biochemical Engineering	3
CSS 467	Bioenergy Feedstock Production	3

**One of the following courses: (3)**

BE 469	Sustainable Bioenergy Systems	3
BE 869	Life Cycle Assessment for Bioenergy and Bioproduct Systems	3

**One of the following courses: (3)**

AFRE 829	Economics of Environ Resources	3
CHE 882	Advanced Biochemical Engineering	3
CHE 883	Multidisciplinary Bioprocessing Laboratory	3
FOR 466	Natural Resource Policy	3
MC 450	International Environmental Law and Policy	3

**Biomedical Engineering Concentration: (16-17)**

To earn a Bachelor of Science degree in Chemical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d., above and the following:

**All of the following courses: (10)**

CHE 481	Biochemical Engineering	3
MMG 409	Eukaryotic Cell Biology	3
PSL 431	Human Physiology I	4

**One of the following courses: (3)**

CHE 883	Multidisciplinary Bioprocessing Laboratory	3
ME 494	Biofluid Mechanics and Heat Transfer	3
MSE 425	Biomaterials and Biocompatibility	3

**Biomedical Engineering Concentration Continued:**

**One of the following courses not taken above: (3-4)**

BMB 471	Advanced Biochemistry Laboratory	3
CHE 883	Multidisciplinary Bioprocessing Laboratory	3
IBIO 341	Fundamental Genetics	4
ME 494	Biofluid Mechanics and Heat Transfer	3
MSE 425	Biomaterials and Biocompatibility	3

**Environmental Concentration: (15)**

To earn a Bachelor of Science degree in Chemical Engineering with an environmental concentration, the student must complete requirements 1., 2., and 3. a., 3.b., and 3.d. above and the following:

**Both of the following courses: (6)**

CHE 481	Biochemical Engineering	3
ENE 280	Principles of Environmental Eng & Science	3

**Three of the following courses: (9)**

AFRE 265	Ecological Economics	3
AFRE 360	Environmental Economics	3
AFRE 465	Corporate Environmental Management (W)	3
CSUS 465	Environmental and Natural Resource Law	3
ENE 481	Environmental Chemistry: Equilibrium Concepts	3
ENE 483	Water and Wastewater Engineering	3
ENE 489	Air Pollution: Science and Engineering	3
IBIO 446	Environmental Issues and Public Policy	3

**Food Science Concentration: (12)**

To earn a Bachelor of Science degree in Chemical Engineering with a food science concentration, students must complete requirements 1., 2., 3. a., 3. b., 3.c., and 3.d., above and all of the following:

**All of the following courses: (9)**

FSC 401	Food Chemistry	3
FSC 440	Food Microbiology	3
MMG 301	Introductory Microbiology	3

**One of the following courses: (3)**

BE 477	Food Engineering: Fluids	3
BE 478	Food Engineering: Solids	3
FSC 325	Food Processing: Unit Operations	3
FSC 455	Food and Nutrition Laboratory	3
FSC 470	Integrated Approaches to Food Product Dev	3



**Polymer Science and Engineering Concentration: (15-16)**

To earn a Bachelor of Science degree in Chemical Engineering with a polymer science and engineering concentration, students must complete requirements 1., 2., 3. a., 3. b., 3.d., above and all of the following:

**All of the following courses: (9)**

CE 221	Statics	3
CHE 472	Composite Materials Processing	3
ME 222	Mechanics of Deformable Solids	3

**Two of the following courses: (6-7)**

CHE 871	Materials Surfaces and Interfaces	3
CHE 872	Polymers & Composites: Mfg, Strc & Prfrmnce	3
MSE 370	Synthesis and Processing of Materials	3
MSE 426	Introduction to Composite Materials	3
PKG 323	Packaging with Plastics	4

**Other Electives for Degree (Variable)**

**Total Credits Required for Degree      128**

These requirements are effective for students admitted to the Chemical Engineering major beginning Fall 2024. The Department of Chemical Engineering and Materials Science constantly reviews program requirements and reserves the right to make changes as necessary. Consequently, each student is strongly encouraged to consult with their advisor to obtain assistance in planning an appropriate schedule of courses.

Some courses may have prerequisites, which are not otherwise required in the program. Students should check course descriptions to ensure they are aware of prerequisites.

## Sample Program

Freshman Year				Sophomore Year			
Fall	Credits	Spring	Credits	Fall	Credits	Spring	Credits
CEM 161	1	CEM 162	1	CEM 351	3	CEM 352	3
CEM 151	4	CEM 152	3	BS 161	3	CEM 355	2
EGR 100	2	EGR 102	2	CHE 201	3	CHE 301	1
MTH 132	3	Elective	1	MTH 234	4	CHE 210	3
ISS 2XX	4	MTH 133	4	PHY 183	4	MTH 235	3
		WRA 101	4			PHY 184	4
						Elective	2
<b>Total</b>	<b>14</b>	<b>Total</b>	<b>15</b>	<b>Total</b>	<b>17</b>	<b>Total</b>	<b>18</b>

Junior Year				Senior Year			
Fall	Credits	Spring	Credits	Fall	Credits	Spring	Credits
CHE 311	3	CHE 321	4	CHE 433	4	CHE 473	3
CHE 431	4	CHE 316	4	CHE 432	3	CHE 434	2
CEM 483(FS)	3	CHE 312	4	Tech Elective	3	Tech Elective	3
<b>OR CEM 484 (SS)</b>							
Elective	2	BMB 401	4	CHE 472 <b>OR</b> 481	3	Elective	3
		<b>OR BMB 461 &amp; 462</b>	<b>6</b>				
IAH 201-210	4			ISS3XX	4	IAH 211 or >	4
<b>Total</b>	<b>16</b>	<b>Total</b>	<b>16/18</b>	<b>Total</b>	<b>17</b>	<b>Total</b>	<b>15</b>

## **CHE Program Educational Objectives (approved February 2016)**

The undergraduate program in chemical engineering at Michigan State University has a strong focus on the integration of engineering science and process design with complementary areas of study in bioprocess engineering, biomedical engineering, environmental engineering, fuels and energy, materials, and food engineering. Graduates are prepared for life-long opportunities to participate in diverse sectors of the economy and to assume leadership roles throughout their professional careers.

The graduates of the Chemical Engineering Program are expected to

- succeed in the practice of chemical engineering or in advanced studies in engineering, scientific, or complementary disciplines;
- assume leadership roles in industry and/or in technological fields;
- contribute to the socio-economic environment of their communities; and
- further develop career skills through life-long learning.