1. University Requirements: (23)
   Writing, Rhetoric and American Cultures (WRA) 4
   Integrative Studies in Humanities (IAH) 8
   Integrative Studies in Social Sciences (ISS) 8
   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

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 Engr Prcn in Polymers & Mats Sys 3

   b. One of the following groups: (4-6)
      **Group 1**
      BMB 401 Basic Biochemistry 4
      **Group 2**
      BMB 461 Biochemistry I 3
      BMB 462 Biochemistry II 3

   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 of technically oriented subject-related courses approved by the student's advisor. Acceptable subjects include, but are not limited to, composites processing or biochemical engineering (in addition to that required in 3. c. above), electronic materials, environment, advanced mathematics, transport phenomena, advanced chemistry, foods, legal and regulatory issues, advanced materials, advanced biology, statistics, biomedical engineering, bioenergy, and polymers.

   **Note:** Elective courses in item 3. e. must include at least 3 credits of engineering topics, which includes courses taught in the College of Engineering as well as courses taught in advanced mathematics, advanced chemistry, advanced biology, advanced statistics, and advanced physics. If Biochemistry and Molecular Biology 482 is taken to fulfill requirement 3.b. it will count as technical elective credit in item 3.e.

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.

Biochemical Engineering Concentration: (11-15)
To earn a Bachelor of Science degree in Chemical Engineering with a biochemical engineering concentration, students must complete requirements 1., 2., 3.a., 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 (4 or 6 credits)**
BMB 401 Comprehensive Biochemistry 4
BMB 461 Advanced Biochemistry I 3
BMB 462 Advanced Biochemistry II 3

**Two or three of the following courses. Students who chose BMB 401 in 3.B. must complete three courses. Students who chose BMB 461 and 462 must complete two courses: (5-9)**
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
MMG 445 Microbial Biotechnology (W) 3
Bioenergy Concentration: (15-16)
To earn a Bachelor of Science degree in Chemical Engineering with a bioenergy engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., 3.d., above and the following:

All of the following courses: (12)
BE 469 Sustainable Bioenergy Systems 3
CHE 468 Biomass Conversion in Engineering 3
CHE 481 Biochemical Engineering 3
CSS 467 Bioenergy Feedstock Production 3

One of the following courses (3-4 credits):
AEC 829 Economics of Environ Resources 3
CHE 882 Advanced Biochemical Engineering 3
CHE 883 Multidisciplinary Bioprocessing Laboratory 3
GLG 471 Applied Geophysics 4
MC 450 International Environmental Law and Policy 3
MMG 445 Microbial Biotechnology (W) 3

Biomedical Engineering Concentration: (15-16)
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., 3.d., above and the following:

All of the following courses: (9)
CHE 481 Biochemical Engineering 3
MMG 409 Eukaryotic Cell Biology 3
PSL 431 Human Physiology I 3

Two of the following courses: (6-7)
BMB 471 Advanced Biochemistry Laboratory (W) 3
CHE 883 Multidisciplinary Bioprocessing Laboratory 3
ME 494 Biofluid Mechanics and Heat Transfer 3
IBIO 341 Fundamental Genetics 4

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., 3.d., above and the following:

All of the following courses: (6)
CHE 481 Biochemical Engineering 3
ENE 280 Principles of Environmental Engr and Science 3

Three of the following courses: (9)
EEP 255 Ecological Economics 3
EEP 320 Environmental Economics 3
EEP 405 Corporate Environmental Management 3
ENE 481 Environ Chemistry: Equilibrium Concepts 3
ENE 483 Water and Wastewater Engineering 3
ENE 489 Air Pollution: Science and Engineering 3
CE 485 Landfill Design 3
CSUS 200 Introduction to Sustainability 3
CSUS 465 Environmental Law and Policy 3
IBIO 446 Environmental Issues and Public Policy 3

Food Science Concentration: (12-13)
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., 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: (3-4)
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: (16-17)
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: (10)
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 (Variable)

Total Credits Required for Degree 128

These requirements are effective for students admitted to the Chemical Engineering major beginning Fall 2014. 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 his/her adviser to obtain assistance in planning an appropriate schedule of courses. Students who have questions about Chemical Engineering should contact the Chemical Engineering and Materials Science Department Advising Office, 3512 Engineering Building, phone 517-432-4916. For scheduling academic advising appointments visit: https://www.egr.msu.edu/adcalendar/

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.

Last revised August 2016
### Sample Program

<table>
<thead>
<tr>
<th><strong>Fall Credits</strong></th>
<th><strong>Spring Credits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 161 1</td>
<td>CEM 162 1</td>
</tr>
<tr>
<td>CEM 151 4</td>
<td>CEM 152 3</td>
</tr>
<tr>
<td>EGR 100 2</td>
<td>EGR 102 2</td>
</tr>
<tr>
<td>MTH 132 3</td>
<td>Elective 1</td>
</tr>
<tr>
<td>ISS 2XX 4</td>
<td>MTH 133 4</td>
</tr>
<tr>
<td>WRA 1XX 4</td>
<td></td>
</tr>
<tr>
<td><strong>Total 14</strong></td>
<td><strong>Total 15</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Fall Credits</strong></th>
<th><strong>Spring Credits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 351 3</td>
<td>CEM 352 3</td>
</tr>
<tr>
<td>BS 161 3</td>
<td>CEM 355 2</td>
</tr>
<tr>
<td>CHE 201 3</td>
<td>CHE 210 3</td>
</tr>
<tr>
<td>MTH 234 4</td>
<td>MTH 235 3</td>
</tr>
<tr>
<td>PHY 183 4</td>
<td>PHY 184 4</td>
</tr>
<tr>
<td>Elective 2</td>
<td></td>
</tr>
<tr>
<td><strong>Total 17</strong></td>
<td><strong>Total 17</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Junior Year</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Credits</td>
</tr>
<tr>
<td>CHE 301 1</td>
</tr>
<tr>
<td>CHE 311 3</td>
</tr>
<tr>
<td>CHE 431 4</td>
</tr>
<tr>
<td>CEM 483 (FS) 3</td>
</tr>
<tr>
<td>or CEM 484 (SS)</td>
</tr>
<tr>
<td>Elective 2</td>
</tr>
<tr>
<td>IAH 201-210 4</td>
</tr>
<tr>
<td><strong>Total 17</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Senior Year</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Credits</td>
</tr>
<tr>
<td>CHE 433 4</td>
</tr>
<tr>
<td>CHE 432 3</td>
</tr>
<tr>
<td>Tech Elective 3</td>
</tr>
<tr>
<td>CEM 472 or 481 3</td>
</tr>
<tr>
<td>ISS 3XX 4</td>
</tr>
<tr>
<td>IAH 201-210 4</td>
</tr>
<tr>
<td><strong>Total 17</strong></td>
</tr>
</tbody>
</table>

### 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.