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

1. 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
   PHYS 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
      Group 2
      BMB 461 Advanced Biochemistry I 3
      BMB 462 Advanced 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 in courses selected from a list of approved technical electives available from the Department of Chemical Engineering and Materials Science. Technical elective courses must include at least 3 credits of engineering topics, denoted with an 'e' next to the course number on the CHE technical elective list.

      NOTE: BMB 462 is taken to fulfill requirement 3.b. and will count as a technical elective credit in item 3.e., not as an engineering 'e' topics course.

2. 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.

3. 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

   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

   Four of the following courses: (19-21 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Five of the following courses: (23-25 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Six of the following courses: (26-28 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Seven of the following courses: (29-31 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Eight of the following courses: (32-34 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Nine of the following courses: (35-37 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Ten of the following courses: (38-40 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3

   Eleven of the following courses: (41-43 credits)
   CHE 884 Advanced Biochemical Engineering 3
   CHE 885 Multidisciplinary Bioprocessing Laboratory 3
   CHE 886 Advanced Biochemical Engineering 3
   CHE 887 Multidisciplinary Bioprocessing Laboratory 3
   MMG 408 Eukaryotic Cell Biology 3
   MMG 422 Prokaryotic Cell Physiology 3
   MMG 432 Microbial Genetics 3
Biochemical Engineering Concentration Continued:

Track 2 (11-12 credits)

Both of the following courses: (6)
- BMB 461 Advanced Biochemistry I
- BMB 462 Advanced Biochemistry II

Two of the following courses: (5-6 credits)
- BMB 805 Protein Structure, Design, and Mechanism
- BMB 829 Methods of Macromolecular Analysis & Synthesis
- CHE 882 Advanced Biochemical Engineering
- CHE 883 Multidisciplinary Bioprocessing Laboratory
- MMG 409 Eukaryotic Cell Biology
- MMG 421 Prokaryotic Cell Physiology
- MMG 431 Microbial Genetics

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
- CHE 481 Biochemical Engineering
- CSS 467 Bioenergy Feedstock Production

One of the following courses: (3)
- BE 469 Sustainable Bioenergy Systems
- BE 869 Life Cycle Assessment for Bioenergy and Bioproduct Systems

One of the following courses: (3)
- AFRE 829 Economics of Environ Resources
- CHE 882 Advanced Biochemical Engineering
- CHE 883 Multidisciplinary Bioprocessing Laboratory
- FOR 466 Natural Resource Policy
- MC 450 International Environmental Law and Policy

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
- MMG 409 Eukaryotic Cell Biology
- PSL 431 Human Physiology I

One of the following courses: (3)
- CHE 883 Multidisciplinary Bioprocessing Laboratory
- ME 494 Biofluid Mechanics and Heat Transfer
- MSE 425 Biomaterials and Biocompatibility

Biomedical Engineering Concentration Continued:

One of the following courses not taken above: (3-4)
- BMB 471 Advanced Biochemistry Laboratory
- CHE 883 Multidisciplinary Bioprocessing Laboratory
- IBIO 341 Fundamental Genetics
- ME 494 Biofluid Mechanics and Heat Transfer
- MSE 425 Biomaterials and Biocompatibility

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
- ENE 280 Principles of Environmental Eng & Science

Three of the following courses: (9)
- CSUS 465 Environmental and Natural Resource Law
- EEP 255 Ecological Economics
- EEP 320 Environmental Economics
- EEP 405 Corporate Environmental Management (W)
- ENE 481 Environmental Chemistry: Equilibrium Concepts
- ENE 483 Water and Wastewater Engineering
- ENE 489 Air Pollution: Science and Engineering
- IBIO 446 Environmental Issues and Public Policy

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
- FSC 440 Food Microbiology
- MMG 301 Introductory Microbiology

One of the following courses: (3)
- BE 477 Food Engineering: Fluids
- BE 478 Food Engineering: Solids
- FSC 325 Food Processing: Unit Operations
- FSC 455 Food and Nutrition Laboratory
- FSC 470 Integrated Approaches to Food Product Dev
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)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 221</td>
<td>Statics</td>
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<tr>
<td>CHE 472</td>
<td>Composite Materials Processing</td>
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<tr>
<td>ME 222</td>
<td>Mechanics of Deformable Solids</td>
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Two of the following courses: (6-7)

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<tr>
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<td>CHE 871</td>
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<tr>
<td>CHE 872</td>
<td>Polymers &amp; Composites: Mfg, Strc &amp; Prfrmnce</td>
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<tr>
<td>MSE 370</td>
<td>Synthesis and Processing of Materials</td>
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<td>MSE 426</td>
<td>Introduction to Composite Materials</td>
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<tr>
<td>PKG 323</td>
<td>Packaging with Plastics</td>
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</table>

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 2017. 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 advisor 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.
### Sample Program

#### Freshman Year

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<thead>
<tr>
<th>Fall</th>
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<th>Credits</th>
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<tr>
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<td>CEM 162</td>
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<td>ISS 2XX</td>
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<td>MTH 133</td>
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<td>WRA 101</td>
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#### Sophomore Year

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#### Junior Year

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<td>CHE 311</td>
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<td>CHE 321</td>
<td>4</td>
</tr>
<tr>
<td>CHE 431</td>
<td>4</td>
<td>CHE 316</td>
<td>4</td>
</tr>
<tr>
<td>CEM 483(FS)</td>
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<td>CHE 312</td>
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<tr>
<td>OR CEM 484 (SS)</td>
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<tr>
<td>Elective</td>
<td>2</td>
<td>BMB 401</td>
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<tr>
<td>OR BMB 461 &amp; 462</td>
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#### Senior Year

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<td>CHE 433</td>
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<td>CHE 432</td>
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<td>CHE 434</td>
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<td>Tech Elective</td>
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<td>IAH 211 or &gt;</td>
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### 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.