## University Requirements: (23)
- Writing, Rhetoric and American Cultures (WRA) 4
- Integrative Studies in Social Sciences (ISS) 8
- Bioscience: BS 161 Cell and Molecular Biology 3

## College Requirements: (30)
- CEM 151 General and Descriptive Chemistry 4
- EGR 100 Introduction to Engineering Design 2
- MTH 132 Calculus I 3
- MTH 235 Differential Equations 3
- PHY 183 Physics for Scientists & Engineers I 4

### 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 Princ 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 462 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 Anlys & 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
ZOL 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
ZOL 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 & Prfrmnc  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, 3508 Engineering Building, phone (517) 432-1352. 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 May 2015
Sample Program

Freshman Year

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Senior Year

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CHE Program Educational Objectives

The undergraduate program in chemical engineering builds a strong foundation for the professional development of its students and prepares them to meet the technological challenges of the future. With a bachelor's degree, the graduates are well equipped for a wide variety of positions as practicing chemical engineers or for graduate studies in competitive engineering and scientific disciplines. The intensive program promotes continued learning and professional development by providing the proper knowledge and stimulation in an ideal setting for personal growth. The program emphasizes its historic, nationally recognized strength in chemical process design, yet draws on the scholarly accomplishments of its faculty to integrate traditional chemical engineering topics with specialized studies in the contemporary fields of materials, bioprocessing, environmental engineering, biomedical engineering, and food engineering.

The faculty of the Chemical Engineering Program is committed to sharing the responsibility of learning with the students, providing a rigorous academic environment that encourages active learning, high quality student performance, and ethical and professional conduct. Through the integration of the knowledge and skills acquired in a demanding set of courses, extracurricular experiences, and faculty expertise and scholarship, the Chemical Engineering Program has established the following objectives.

The graduates of the Chemical Engineering Program will

- be successful in the practice of chemical engineering or in advanced studies in engineering, scientific or complementary disciplines;
- assume leadership roles in industry and/or their communities;
- contribute to the economic environment of their communities; and
- maintain career skills through life-long learning.

Last revised August 2015