Oh, the things you will do!

On behalf of all of our staff, Welcome Spartan Engineer!

You are embarking on a major journey in life. After 13 years of taking courses mostly in common with all of the other students your age, you are now beginning preparation for a profession, and investing time and resources in a college education directed to your specific goals.

Success in Engineering in the 21st century requires breadth beyond classroom studies and a standard curriculum. To reach your goals, the planning starts now. You need to spend your years as a Spartan Engineer developing the building blocks for a career in engineering or a related field and perhaps additional study in graduate school.

Making your plan starts today at your Academic Orientation Program (AOP) and will continue through your career by interacting with the various units in the office of Engineering Undergraduate Studies (UGS). Our many ways to provide you support and help you broaden your experiences are further described in this handbook. Keep this book for your planning and visit our offices to assist you in the many opportunities highlighted above. Our help starts today, in planning your first year of classes.

You are a Spartan Engineer. Welcome and … Go Green!

Assistant Dean for Undergraduate Student Affairs
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<tr>
<th>Office/Department</th>
<th>Location</th>
<th>Phone #</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Advising</td>
<td>1415 EB</td>
<td>517-355-6616 ext. 3</td>
<td><a href="http://www.egr.msu.edu/undergraduate/academic/advisors">http://www.egr.msu.edu/undergraduate/academic/advisors</a></td>
</tr>
<tr>
<td>Academic Advising First Year Engineering Students</td>
<td>W8a Wilson Hall</td>
<td>517-355-6616 ext. 2</td>
<td><a href="http://www.egr.msu.edu/undergraduate/academic/advisors">http://www.egr.msu.edu/undergraduate/academic/advisors</a></td>
</tr>
<tr>
<td>Admissions</td>
<td>250 Hannah Admin. Bldg.</td>
<td>517-355-8332</td>
<td><a href="http://www.admissions.msu.edu">www.admissions.msu.edu</a></td>
</tr>
<tr>
<td>Campus Living Resources</td>
<td>C101 Wilson Hall</td>
<td>1-877-9LIVEON</td>
<td><a href="http://www.liveon.msu.edu">www.liveon.msu.edu</a></td>
</tr>
<tr>
<td>Chemistry Department</td>
<td>185 Chemistry</td>
<td>517-355-9715</td>
<td><a href="http://www.chemistry.msu.edu">www.chemistry.msu.edu</a></td>
</tr>
<tr>
<td>CoRe</td>
<td>W8a Wilson Hall</td>
<td>517-355-6616 ext. 2</td>
<td><a href="http://www.egr.msu.edu/core/">http://www.egr.msu.edu/core/</a></td>
</tr>
<tr>
<td>Counseling Center</td>
<td>207 Student Services</td>
<td>517-355-8270</td>
<td><a href="http://www.counseling.msu.edu">www.counseling.msu.edu</a></td>
</tr>
<tr>
<td>Diversity Programs Office (DPO)</td>
<td>1108 EB</td>
<td>517-355-8310</td>
<td><a href="http://www.egr.msu.edu/dpo">www.egr.msu.edu/dpo</a></td>
</tr>
<tr>
<td>English Language Center (ELC)</td>
<td>B204 Wells Hall</td>
<td>517-353-0800</td>
<td><a href="http://www.elc.msu.edu">www.elc.msu.edu</a></td>
</tr>
<tr>
<td>Financial Aid</td>
<td>252 Student Services</td>
<td>517-353-5940</td>
<td><a href="http://www.finaid.msu.edu">www.finaid.msu.edu</a></td>
</tr>
<tr>
<td>IAH Department</td>
<td>200 Linton Hall</td>
<td>517-353-3560</td>
<td><a href="http://www.cisah.msu.edu">www.cisah.msu.edu</a></td>
</tr>
<tr>
<td>ISS Department</td>
<td>302 Berkey Hall</td>
<td>517-355-9733</td>
<td><a href="http://www.cis-ss.msu.edu">www.cis-ss.msu.edu</a></td>
</tr>
<tr>
<td>Math Department</td>
<td>C212 Wells Hall</td>
<td>517-353-0844</td>
<td><a href="http://www.math.msu.edu">www.math.msu.edu</a></td>
</tr>
<tr>
<td>Math Learning Center (MLC)</td>
<td>C126 A Wells Hall</td>
<td>517-884-7414</td>
<td><a href="http://www.math.msu.edu/mlc">www.math.msu.edu/mlc</a></td>
</tr>
<tr>
<td>Office Intern'l. Stud. &amp; Scholars (OISS)</td>
<td>105 Internat'l Center</td>
<td>517-353-1720</td>
<td><a href="http://www.oiss.msu.edu">www.oiss.msu.edu</a></td>
</tr>
<tr>
<td>Physics Department</td>
<td>1312 BPS Building</td>
<td>517-355-9200 ext. 3</td>
<td><a href="http://www.pa.msu.edu">www.pa.msu.edu</a></td>
</tr>
<tr>
<td>Department of Police &amp; PublicSafety (DPPS)</td>
<td>1120 Red Cedar Rd.</td>
<td>517-355-2221</td>
<td><a href="http://www.police.msu.edu">www.police.msu.edu</a> (sign up for emergency text alerts here)</td>
</tr>
<tr>
<td>Registrar</td>
<td>150 Hannah Admin. Bldg.</td>
<td>517-355-3300</td>
<td><a href="http://www.reg.msu.edu">www.reg.msu.edu</a></td>
</tr>
<tr>
<td>Study Abroad</td>
<td>109 Internat'l Center</td>
<td>517-353-8920</td>
<td><a href="http://www.studyabroad.msu.edu">www.studyabroad.msu.edu</a></td>
</tr>
<tr>
<td>The Center (internships, co-ops, career services)</td>
<td>1340 EB</td>
<td>517-355-5163</td>
<td><a href="http://www.egr.msu.edu/careers">www.egr.msu.edu/careers</a></td>
</tr>
<tr>
<td>Neighborhood Student Success Collaborative</td>
<td>170 Bessey Hall</td>
<td></td>
<td><a href="http://nssc.msu.edu/">http://nssc.msu.edu/</a></td>
</tr>
<tr>
<td>Women in Engineering (WIE) Student Success</td>
<td>1108A EB</td>
<td>517-432-1354</td>
<td><a href="http://www.egr.msu.edu/wie">www.egr.msu.edu/wie</a></td>
</tr>
<tr>
<td>Women in Engineering (WIE) K-12 Outreach</td>
<td>1410A EB</td>
<td>517-884-0054</td>
<td><a href="http://www.egr.msu.edu/wie">www.egr.msu.edu/wie</a></td>
</tr>
<tr>
<td>Writing Center</td>
<td>300 Bessey Hall</td>
<td>517-432-3610</td>
<td><a href="http://www.writing.msu.edu">www.writing.msu.edu</a></td>
</tr>
</tbody>
</table>
2017 - 2018 Academic Calendar
For a complete listing of important dates, please visit the registrar's website at
https://www.reg.msu.edu/ROInfo/Calendar/academic.asp

Fall 2017

August 26
New Freshmen and Transfer students attending an AUGUST orientation
can move into residence halls beginning at 8 am

August 27
New Freshmen and Transfer students who attended JUNE or JULY
orientation can move into residence halls beginning at 8 am

August 30
Classes begin, Monday schedule is observed

September 4
Labor Day- University closed

September 6
End of open add period; 8PM

September 25
End of tuition refund period

October 18
Middle of Semester, LAST day to drop classes with no grade
reported; 8PM

November 23-24
Thanksgiving holiday- University closed

December 8
End of classes for Fall Semester

December 8
Engineering Design Day

December 11-15
Final exams

Spring 2018

January 8
Classes begin

January 12
End of open add period; 8PM

January 15
Martin Luther King, Jr. Day, no classes, university remains open

February 2
End of tuition refund period

February 28
Middle of Semester, LAST day to drop classes with no grade
reported; 8PM

March 5-9
Spring break

April 27
Classes end

April 27
Engineering Design Day

April 30-May 4
Final exams
Academic Advising

Who are academic advisors?
Academic advisors are professionals with advanced degrees in counseling, education, university administration and related fields. Academic advisors are dedicated to student’s academic success and are knowledgeable about university policy. We are here to guide you along the way and provide valuable information to help you make good academic decisions. Please check in at Wilson Hall, Room W-8a if you would like to meet with an advisor.

Walk in advising is available:

Mondays and Wednesdays: 1pm-4pm

Tuesdays and Thursdays: 10am-12pm and 1pm-4pm

Questions? Call (517) 355-6616 x2 or schedule an appointment online at https://msu.campus.eab.com

FIRST YEAR ADVISORS
- Candyce Hill
- Jeffrey Tsang

SOPHOMORE THROUGH SENIOR ADVISORS
For the most updated information, check http://www.egr.msu.edu/undergraduate/academic/advisors

Applied Engineering Sciences
- Joyce Samuel

Biosystems Engineering
- Hannah Brodhead

Chemical Engineering, Materials Science Engineering
- Lindsay Naylor

Civil Engineering, Environmental Engineering
- TBD

Computer Engineering, Electrical Engineering
- Sean Fochtman
How often should I meet with my advisor?

- At least once a semester
- To receive assistance with major selection, schedule planning, test-taking, study skills, utilizing resources, career planning, and much more
- We encourage you to meet with an advisor in person; while some questions can be handled by email, many issues benefit from a two-way conversation

Before visiting your advisor, you should:

- Reflect on how you are doing in your classes
- Review the major/degree requirements for the majors that interest you
- Review course pre-requisites [http://www.reg.msu.edu/Courses/Search.asp](http://www.reg.msu.edu/Courses/Search.asp) and schedule of courses [http://schedule.msu.edu/](http://schedule.msu.edu/)
- Bring a preliminary schedule of courses you intend to take
- Write down your questions and bring them to your appointment

**Academic Programs Catalog**
Students should consult with their advisors to learn which specific requirements apply to their degree programs: It can be viewed online at: [http://www.reg.msu.edu/AcademicPrograms/default.asp](http://www.reg.msu.edu/AcademicPrograms/default.asp)

**Student Handbook**
*Spartan Life: Student Handbook and Resource Guide* is a helpful resource guide to campus programs and services and also includes rules, regulations, rights and responsibilities that have been established in the interest of intellectual and personal development while protecting individual freedoms. It can be found at: [http://splife.studentlife.msu.edu](http://splife.studentlife.msu.edu)

**How many credits do I need to be a Freshman, Sophomore, Junior, or Senior?**

<table>
<thead>
<tr>
<th>Class</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>0-27</td>
</tr>
<tr>
<td>Sophomore</td>
<td>28-55</td>
</tr>
<tr>
<td>Junior</td>
<td>56-87</td>
</tr>
<tr>
<td>Senior</td>
<td>88+</td>
</tr>
</tbody>
</table>
Admission to the College of Engineering

In order to enroll in 300 & 400 level engineering courses, students must be admitted to the college. Students in declared engineering majors are reviewed every semester until they reach 56 credits and are admitted once they have:

- completed the required courses
- declared a degree granting Engineering major *(No-Preference is not a degree-granting major)*
- attained a specific combination grade point average
- Students must have a minimum 2.0 grade point average or higher in all mathematics courses completed at the time of admission. This does not include MTH 1825

In some cases, an application to the college may be necessary.

- For engineering students with a high number of AP/transfer credits: If core courses are not completed prior to reaching 56 credits, you will have to temporarily change your major out of engineering
- Juniors and seniors who have a declared major outside of engineering
- An already admitted student who wishes to change to another engineering major

Applications available from the 3rd-15th weeks of each semester at:
http://www.egr.msu.edu/undergraduate/academic/admission-engineering

Courses Required for Admission to the College of Engineering

- MTH 132 - Calculus I
- MTH 133 - Calculus II
- CEM 141 - General Chemistry or CEM 151 - General and Descriptive Chemistry for all majors except Computer Science
  - CEM 151 is required for ChE & MSE majors and is ONLY offered in the Fall
  - CEM 152 is required for ChE & MSE majors and is ONLY offered in the Spring
- PHY 183 or 183B - Physics for Scientists and Engineers I
- EGR 100 - Introduction to Engineering Design
- EGR 102 - Introduction to Engineering Modeling OR CSE 231 - Introduction to Programming I, (for Computer Engineering, Computer Science and Mechanical Engineers majors only) OR CSE 220 - Programming in C, (for Electrical Engineering majors only)
Admission to Engineering majors requires the following combined (combo) GPA:

- Mechanical Engineering – 3.1
- Applied Engineering Sciences – 3.0
- Biosystems, Chemical, Civil, Computer Engineering, Computer Science, Electrical, Environmental, Materials Science – 2.9

Admission to the College of Engineering is based on your Combined (Combo) GPA. Your combined combo grade point average is the average of your cumulative GPA and your technical GPA.

Your Cumulative GPA is an average of the grades you received for all courses you have taken for credit at MSU. First, multiply the credits for each MSU course you have taken by grade you received to get your points. Then, divide your total points by your total credits to get your cumulative GPA. Example:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Multiply</th>
<th>Grade Rec’d</th>
<th>Equals</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENT 205</td>
<td>3</td>
<td>x</td>
<td>2.5</td>
<td>=</td>
<td>7.5</td>
</tr>
<tr>
<td>CEM 141</td>
<td>4</td>
<td>x</td>
<td>3.0</td>
<td>=</td>
<td>12.0</td>
</tr>
<tr>
<td>CEM 161</td>
<td>1</td>
<td>x</td>
<td>4.0</td>
<td>=</td>
<td>4.0</td>
</tr>
<tr>
<td>ISS 215</td>
<td>4</td>
<td>x</td>
<td>3.0</td>
<td>=</td>
<td>12.0</td>
</tr>
<tr>
<td>MTH 132</td>
<td>3</td>
<td>x</td>
<td>3.0</td>
<td>=</td>
<td>9.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>44.5</strong></td>
</tr>
</tbody>
</table>

44.5 (total points) ÷ 15 (total credits) = 2.966 cumulative GPA

Your Technical GPA is an average of the grades you have received for all technical courses, which include most courses taken in the College of Engineering, Natural Science, Biosystems Engineering courses, and selected courses from Lyman Briggs College. A more complete list of technical courses can be found at http://www.egr.msu.edu/advising/gpa/gpa-calculations

The technical GPA calculation is the same as the Cumulative GPA, except that it only includes your science and engineering related courses. If you have repeated a course, only the most recent grade should be used. In this example, notice that ISS 215 from the list above is not included because it is not technical. Example:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Multiply</th>
<th>Grade Rec’d</th>
<th>Equals</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENT 205</td>
<td>3</td>
<td>x</td>
<td>2.5</td>
<td>=</td>
<td>7.5</td>
</tr>
<tr>
<td>CEM 141</td>
<td>4</td>
<td>x</td>
<td>3.0</td>
<td>=</td>
<td>12.0</td>
</tr>
<tr>
<td>CEM 161</td>
<td>1</td>
<td>x</td>
<td>4.0</td>
<td>=</td>
<td>4.0</td>
</tr>
<tr>
<td>MTH 132</td>
<td>3</td>
<td>x</td>
<td>3.0</td>
<td>=</td>
<td>9.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>32.5</strong></td>
</tr>
</tbody>
</table>

32.5 (total points) ÷ 11 (total credits) = 2.9545 technical GPA
Your Engineering Degree

Your engineering degree consists of four main parts:

1. University Requirements (required of every MSU students)
2. College Requirements (required of all Engineering students)
3. Major Requirements (set of courses just for your major)
4. Electives (classes of your choosing to help you reach your total to graduate)

There are also opportunities to add optional concentrations in most majors, minors in or out of the College of Engineering, and additional majors.

1. University Requirements

Writing, Rhetoric, and American Cultures (WRA)
- All MSU students must complete two WRA courses. The Tier I class is WRA101, and is generally taken during the first year. Tier II classes are always completed through a student’s major, usually in the junior or senior year.
  - WRA 101 Tier I level
  - One at the Tier II level

Integrative Studies in Social Sciences (ISS)
- All MSU students must complete two ISS courses. These courses can be completed at any time during the undergraduate program.
  - One ISS 2XX level course
  - One ISS 3XX level course (pre-requisite is ISS 2XX level)

Integrative Studies in Arts and Humanities (IAH)
- All MSU students must complete two IAH courses. These courses can be completed at any time during the undergraduate program.
  - IAH 201-210 (pre-requisite is WRA 101)
  - IAH 211 or higher (perquisite is IAH 201-210)

Integrative Studies Diversity Requirement
- MSU undergraduates must complete courses in at least two of three diversity categories (“D”, “N” & “I”) as part of their IAH and/or ISS requirements. “N” – emphasizes national diversity; “I” – emphasizes international and multicultural diversity and “D” – emphasizes both national and international/multicultural diversity.
Bioscience

- **MOST** of the engineering majors allow for any of the following: BS 161, ENT 205, IBIO 150, MMG 141, MMG 201, PLB 105, PSL 250
- Environmental Engineering (ENE) and Chemical Engineering (ChE) majors must take BS 161
- **Biosystems Engineering (BE)** majors must take BS 161 and BS 162. *(It is important to keep in mind that BS 161 is a prerequisite for BS 162)*
- The **Computer Science (CSE)** major also has stipulations regarding the bioscience requirement. Please refer to the Computer Science curriculum guide for this information.
- **Biomedical Concentration**: Need BS 161

2. College of Engineering Requirements

Design Courses

As part of the CoRe Experience academic program, first-year engineering students are introduced to the team design process and analytical tools used in the engineering profession. These courses immerse students in hands-on engineering activities from their first days on campus.

**All majors take EGR 100** – Introduction to *Engineering Design*

Team-based, interdisciplinary projects will be used to introduce students to the principles of engineering design processes. Teamwork, oral and written communication, career preparation, engineering ethics and other topics will also be discussed.

**One technical computing class must be taken, depending on your intended major**

- **EGR 102** – Introduction to *Engineering Modeling*. Students will learn how to systematically identify and deconstruct engineering problems using tools such as advanced spreadsheets and engineering software applications such as MATLAB. Students will analyze various engineering systems, through the use of a variety of mathematical models. For students in **Applied Engineering Sciences, Biosystems Engineering, Civil Engineering, Chemical Engineering, Environmental Engineering, and Materials Science**.
- **CSE 231** – Introduction to *Programming I*. CSE 231 is an introduction to programming course. Using the Python language students will learn how to design, implement, and test programs to solve problems such as those in engineering, mathematics and science. For students in **Computer Science, Computer Engineering and Mechanical Engineering**.
- **CSE 220** – Programming in C. CSE 220 is a programming course geared toward electrical engineering. It covers basics of programming in C, including data types, operators, control, functions, arrays, pointers, file processing, testing and debugging. For students in **Electrical Engineering**.
**Mathematics**

Over the course of your studies, you are expected to display competency in calculus. These mathematics courses are typically completed in the first two or two and half years of a student’s academic program.

- **MTH 132** Calculus I*
- **MTH 133** Calculus II
- **MTH 234** Multivariable Calculus
- **MTH 235** Differential Equations (not required for CpSCSE)

*If you earn a repeatable grade in a math course (1.0 or 1.5), it is HIGHLY RECOMMENDED you repeat that course BEFORE moving on to the next math course.

Placement in mathematics the first year is determined by the student’s high school math background as evaluated by the MSU Mathematics Placement Test, ACT or SAT Math Score, or Advanced Placement (AP) test. Students who do not place directly into the calculus series must successfully complete one of the sequences below before enrolling in MTH 132:

- **Sequence A:** MTH 116 – College Algebra & Trigonometry
- **Sequence B:** MTH 103 – College Algebra
  - and MTH 114 – Trigonometry
- **Sequence C:** MTH 1825 – Intermediate Algebra
  - and MTH 116 – College Algebra & Trigonometry.

**Important to note** that the credits earned in MTH 1825 do not count toward graduation.

**Chemistry**

All engineering students (except Computer Science majors) are required to complete at least one introductory course in general chemistry, usually taken during the freshman year.

- **CEM 141** – General Chemistry (must be in MTH 103 or higher)
  - Required for: Applied Engineering Sciences, Biosystems Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, and Mechanical Engineering
- **CEM 151** – General and Descriptive Chemistry (must be in MTH 116 or higher)
  - Required for: Chemical Engineering, Environmental Engineering, and Materials Science and Engineering

**Special Note for Chemical Engineering and Materials Science and Engineering Majors**, please keep in mind these courses are only offered once a year.

- CEM 151 – Fall Only
- CEM 152 – Spring Only
- CEM 351 – Fall Only
- CEM 352 – Spring Only
- CEM 355 – Spring Only
Physics
All engineering students are expected to develop an understanding of certain fundamental principles of physics as a prerequisite to future engineering coursework. This requirement is met by taking two semesters of calculus-based physics.

- **PHY 183** – Physics for Scientists and Engineers I
- **PHY 184** – Physics for Scientists and Engineers II

**PHY 231** and **PHY 232** are not calculus-based, and by themselves do **not** fulfill the College of Engineering Physics requirements. If you have test/dual enrollment credit for these, you will also need the “bridge” courses for the calculus components.

$$\text{PHY 231} + \text{PHY 233B} = \text{PHY 183}$$
$$\text{PHY 232} + \text{PHY 234B} = \text{PHY 184}$$

### 3. Major Requirements

Major requirements differ across the 10 majors. Specific courses can be found on the curriculum guides in the back half of this handbook, or at [http://www.egr.msu.edu/undergraduate/academic/degree-programs](http://www.egr.msu.edu/undergraduate/academic/degree-programs). Some courses count in several majors, so if you are undecided, look for courses that count in multiple majors.

### 4. Electives

Engineering degrees require 120 or 128 credits, depending on which one you choose. Degree requirements for your major will not total 120/128, so you get to fill those credits with **electives**. You can “spend” your elective credits any way you wish, but know that they are a part of your degree.

### NOTES

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
Biomedical Engineering at Michigan State

What do biomedical engineers do?
Biomedical engineers develop devices and procedures that solve medical and health-related problems. Biomedical engineers develop new processes, materials, and devices which can be used in the prevention, detection, and treatment of disease, patient rehabilitation, and overall health.

Where is biomedical engineering at MSU?
Biomedical engineering solutions require knowledge of an underlying engineering discipline. At MSU, students choose an engineering major first and then select biomedical electives as part of the major curriculum. The biomedical engineering concentration may be added to the following six engineering disciplines: Biosystems, Chemical, Computer, Electrical, Materials Science, or Mechanical Engineering.

Students interested in biomedical engineering should speak with their academic advisor early in their careers, as the biomedical concentration has specific bioscience requirements.

1. Biomedical Concentration with Biosystems Engineering
Biosystems engineers identify and solve problems at the interface of engineering and biology. In the biomedical area, Biosystems Engineering students have opportunities for undergraduate research in areas such as microbial modeling and biosensors for rapid detection of pathogens. In this application area, biosystems engineers find employment with pharmaceutical/healthcare companies, medical supply companies, and federal agencies, as well as continuing their studies in medical, veterinary, and graduate school.

2. Biochemical/Biomedical Concentrations with Chemical Engineering
Historically, chemical engineers have designed devices, pharmaceutical processes, and artificial organs (such as the artificial kidney). Chemical engineers are making significant contributions in computational and functional genomics, biosensors, cell and tissue engineering, biomolecular engineering, gene therapy, metabolic engineering, high-throughput drug screening, and drug formulation and delivery.

3. Biomedical Concentration with Electrical and Computer Engineering
Electrical and Computer Engineering students can take courses in the areas of bio-imaging and biomedical applications of signals and systems, and are given opportunities to conduct independent research with faculty in the areas of biomedical engineering. With the departments focus on developing physical systems and data analysis methods for biomedical applications, some of the current research includes: modeling of physiological systems, cardiovascular physiology, biomedical ultrasonics, medical imaging, neural engineering, development of implantable devices and biomedical signal processing.
4. Biomedical Materials Concentration with Materials Science & Engineering
Biomedical materials engineers create new materials and devices that are used to treat
diseases and repair damaged tissues by combining their knowledge and skills in
engineering materials design with biology and chemistry. They may conduct research in
areas such as tissue engineering (creating new tissues like bone and muscle) and
implant development (like total knee and hip replacements). It also serves for the design
of devices used in various medical procedures, such as screws and plates used in
orthopedics. Some will specialize in orthopedics and sports medicine, while others will
work in areas such as implant design and manufacturing.

5. Biomedical Concentration with Mechanical Engineering
Mechanical engineers combining biomedical engineering are trained in biomechanical
engineering and find employment designing, for example, prosthetics, artificial joints,
automotive safety equipment, robotics for telemedicine, heart valves, left ventricle assist
devices, and the whole range of medical devices. Research by biomechanical engineers
includes studying the strength of bones and soft tissues, the motion of cells, the
kinematics of human motion, and the flow of blood.

Notes
Environmental Engineering at Michigan State

What are Environmental and Ecosystems Engineers?

Environmental and ecosystems engineers integrate physical, chemical, biological, mathematical, and engineering principles to address environmental problems. They advance fundamental understanding of human impacts on the environment and the environment’s response to these impacts.

Examples of engineering for the environment:
- water and wastewater treatment
- treatment and prevention of diffuse source pollution
- industrial pollution control
- groundwater and hazardous waste site remediation
- constructed wetlands and vegetative buffers
- green process engineering
- air pollution monitoring, control, and permitting
- ecosystems restoration and adaptation to climate change impacts
- conversion of waste to resources

Where is Environmental and Ecosystems Engineering at MSU?

B.S. Environmental Engineering
The Environmental Engineering major prepares students with a solid background in chemical, biological, and physical processes, allowing them to analyze, design, and manage environmental systems and associated infrastructure, such as water supplies, wastewater treatment facilities, air pollution control systems, surface and groundwater resources, and landfills.

B.S. Biosystems Engineering (Ecosystems Engineering Concentration)
The Biosystems Engineering major (ecosystems engineering concentration) prepares students to analyze, design, and control systems and processes with critical biological components, with a focus on natural resources, such as ecosystems restoration, treatment wetlands, watershed management, biomass conversions, or other biologically-centered challenges.

B.S. Chemical Engineering (Environmental Engineering Concentration)
The Chemical Engineering major (environmental engineering concentration) prepares students to design and operate manufacturing facilities that chemically-physically-biologically transform raw materials to finished products, with a focus on environmentally friendly processing that reduces pollution and maximizes benefit.
Additional Minors

MSU has a number of minors available to students. See the Academic Programs Catalog at https://reg.msu.edu/AcademicPrograms/Programs.aspx?PType=MNUN for an up to date list. The College of Engineering offers 3 minors:

**Minor in Computer Science:** The academic minor in Computer Science will provide a foundation in Computer Science. Students wanting to complete the minor must apply to the Department of Computer Science at the time of completion of CSE 231 and CSE 260 and have an average of at least 3.0 for those two courses combined. Enrollment may be limited. Permission is required to take more than 18 CSE credits.

For requirements and application, please visit: http://www.cse.msu.edu/Students/Current_Undergrad/Minor.php

**Minor in Energy:** The Minor in Energy, administered by the College of Engineering, provides students with a foundation in energy science that focuses on topics of fundamental physical principles guiding energy generation, utilization, conservation, engineering applications and the impact of energy within a societal and geological context. Students gain a perspective in energy science that is applicable to many disciplines and highly interdisciplinary. It offers opportunities for students to prepare to work in industry, research, or government, as well as preparation for graduate studies in energy science.

Application forms are available at www.egr.msu.edu/academics/multi-disciplinary

Requirements for the Minor in Energy can be found at https://reg.msu.edu/AcademicPrograms/ProgramDetail.aspx?Program=8075

**Minor in Materials Science:** The Minor in Materials Science and Engineering provides students with a basic foundation in materials science that is applicable to many disciplines. The minor also offers opportunities for students to work in industry, research, or government, as well as to prepare for graduate study in materials science.

Students who plan to complete the requirements for the minor must complete an online application to the Department of Chemical Engineering and Materials Science. To be accepted into the minor, the student must be admitted into the College of Engineering. Enrollment for some MSE courses may be limited.

For requirements and application, please visit: https://www.chems.msu.edu/academics/undergraduate/mse/minor-application
Schedule Planning Worksheets
Remember that your math placement will tell us where you will be starting with a number of courses. Listed on the next few pages are sample first and second year schedules for the possible starting points in math.

**MTH 1825 placement, first year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
<th>Summer</th>
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<tr>
<td>WRA 101</td>
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<td>CEM 141</td>
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<tr>
<td>ISS 2XX</td>
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<td>CEM 161</td>
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Total 14-15   Total 14   Total 3

**MTH 1825 placement, second year**

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<td>PHY 183</td>
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<td>EGR 100</td>
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Total 13-14   Total 14   Total

**MTH 103 placement, first year**

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<td>MTH 132</td>
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<td>MTH 103</td>
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Total 14-15   Total 14-15   Total 3
### MTH 103 placement, second year

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<td><strong>13-15</strong></td>
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### Notes

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Academic Resources

Academic Assistance
There are many engineering and university resources available (free of cost!) to help you with the transition to an advanced and scholarly way of thinking and writing. Those resources include:

- Your academic advisor
- Chemistry Help Room, Rooms 81 and 83 Chemistry Building
- CoRe tutors and Peer Leaders in the South Neighborhood
- Guided Learning Center (GLC), 1109 EB
- Math Learning Center and Neighborhood Engagement Centers
- Writing Center, 300 Bessey Hall

Diversity Programs Office (DPO) and Guided Learning Center (GLC)
The DPO is proud to support and provide resources for all students, with a particular emphasis on assisting groups underrepresented in Engineering. The DPO offers the following services, free of charge!

- The Guided Learning Center offers academic assistance in any course through one-on-one tutoring sessions
- Professional development
- Resource materials
- Speakers, trips, events, and programs
- Opportunities for students to network with faculty, staff, and career professionals
- A freshman/sophomore course, Diversity and Engineering, (EGR 160)
  - Business protocol, resume writing, interviewing, and study skills
  - Practicing engineers come to class and discuss professional development

These services are made possible through cooperation with other Engineering and MSU departments, the volunteerism of our alumni and friends, and generous grants and gifts resulting from partnerships with numerous corporations and non-profit organizations. For more information, please visit our website at [www.egr.msu.edu/dpo](http://www.egr.msu.edu/dpo) or call us at (517) 355-8310.

The DPO Staff:
Theo Caldwell, Director
Kyle Foster, Assistant Director
Lisa Henry, Educational Program Coordinator
Ciera Trice, Program Assistant
Robin Smith, Office Assistant III
CoRe Experience
The College of Engineering CoRe Experience is an integrated program designed around the success of early engineering students. The CoRe Experience consists of both academic and co-curricular activities. The mission of the CoRe Experience is to provide early engineering students with unmatched learning opportunities within a supportive community that encourages academic, personal, and professional achievement, foster life-enriching connections between students and their peers, faculty members, advisors, and corporate representatives, cultivate students’ skills that encourage lifelong learning, and demonstrate to students the critical roles of engineers in contributing to society. For more information, please visit our website at http://www.egr.msu.edu/core/or call us at (517) 355-6616 Ext. 2

The CoRe Staff-
S. Patrick Walton, Sc.D., Director
Carmellia Davis-King, Co-Curricular Director
Timothy Hinds, CoRe Academic Director
Sandra Christlieb, Project Engineer
Aimee Reynolds, Office Assistant III

Engineering Education Abroad
At MSU, we take pride in being a leader in study abroad. In the College of Engineering, we strive to help our students prepare to compete in this growing global climate. One of the many ways to do this is to study abroad during the course of your studies here at State. Study abroad options include year-long, semester, and summer stay options.

We recommend that students who plan to go abroad begin the planning process with their advisor early on in their academic careers. It is advisable to reserve at least one IAH or ISS requirement for use while abroad if students intend to study abroad.

Besides Engineering-specific programs, you can also choose from other MSU sponsored programs. The Education Abroad Office is located in 109 International Center, (517) 353-8920.

For more information on Engineering-specific programs, please visit our website at www.egr.msu.edu/study-abroad, stop by 1108 Engineering Building, or call us at (517) 432-2012.

The Education Abroad Staff-
Maggie Blair-Ramsey, Study Abroad Coordinator
The College of Engineering: Education Abroad Programs Grid provides an overview of the education programs sponsored by the College of Engineering. There is information on each program related to the semester the program is offered, the “ideal” class standing when a student might participate on the program, and the best suited major for each program. One will find the list of programs down the left-hand side of the grid, and one will find the semester, class standing, and majors across the top of the grid.

<table>
<thead>
<tr>
<th>PROGRAMS</th>
<th>FALL</th>
<th>SPRING</th>
<th>SUMMER</th>
<th>WINTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecole Catholique d'Arts et Metiers (France)</td>
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<tr>
<td>Ecological Engineering in the Tropics (Costa Rica)</td>
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<tr>
<td>*Energy Tomorrow: Summer Program (Australia)</td>
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<tr>
<td>Engineering in Hannover, Germany</td>
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<td>Hong Kong University of Science and Technology</td>
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<td>National Taiwan University</td>
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<td>RWTH-Aachen University (Germany)</td>
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<tr>
<td>*Renewable Biobased Energy Systems (Europe)</td>
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<td>Summer in Madrid</td>
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<td>Technical University in Denmark</td>
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<tr>
<td>Tohoku University (Japan)</td>
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<td>University College Dublin: Physics Summer</td>
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<td>University of Politecnica de Madrid</td>
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<td>University of New South Wales (Australia)</td>
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<td>University of KwaZulu-Natal (South Africa)</td>
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<tr>
<td>10 Trending Technologies in Engineering (Spain)</td>
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</table>

* = indicates that this program is possible for the semester, class standing, and major identified across the top of the grid.
*

= check with the College of Engineering Study Abroad Coordinator to determine if this program is running during the current academic year.
Scholarship Information
The College of Engineering administers a variety of scholarships from corporate and private donors in addition to the various financial aid programs available through the Office of Financial Aid. These engineering awards are generally based on academic excellence and are available for returning students. Scholarship applications will be available after January 1st of each year and are due in February. For further information visit: www.egr.msu.edu/undergraduate/resources/scholarship

Women in Engineering Program (WIE)
The Women in Engineering Program (WIE) encourages students of all backgrounds to pursue careers in Engineering. While our particular emphasis is assisting women students, we collaborate with others in the College and University to provide an environment that is conducive to all students’ success, providing opportunities for academic, personal and professional growth. WIE programs include mentoring opportunities, outreach programs, and connection to important resources. WIE also supports the Society of Women Engineers, MSU Women in Computing and Phi Sigma Rho, three very active student organizations in the College of Engineering. For more information about WIE, visit our website at: www.egr.msu.edu/wie

The WIE staff:
Judy Cordes, Director of Women in Engineering for Student Success
Teresa VanderSloot, Director of Women in Engineering for Recruiting and Outreach

Student Organizations
MSU has hundreds of student organizations, please visit:
http://studentlife.msu.edu/student-organizations-activities

For information on international-specific student groups, please visit:
http://oiss.isp.msu.edu/students/clubs.htm.

The College of Engineering has about thirty student groups just for engineers! Find the chapter of your national/international disciplinary organization, or join a group that crosses all majors and interests. Please visit:
http://www.egr.msu.edu/student-groups

The Center for Spartan Engineering
Experiential Engineering Education is a broad term used to describe co-curricular programs that enhance the classroom educational experience. These opportunities may include traditional cooperative (co-op) education and internship programs, on-campus research or intern positions, study abroad opportunities, service-learning, and other non-traditional approaches to learning.
Job Journey- Suggested Activities for Career Engagement

FIRST! Create and build your Handshake profile (see following page)

Engage

☐ Research and list 20 different job titles of interest (Glassdoor and Onet are some good websites to get started)
☐ Research and list 20 different companies and/or industries of interest
☐ Try out different student groups and find at least 1 that you will join and become actively involved: http://www.egr.msu.edu/student-groups
☐ Not sure of your career path or have questions? Drop in for an advising appointment. Keep an eye out for special Wilson Hall advising hours!

Educate

☐ Draft resume and have it critiqued by The Center
  ○ Need help getting started? Stop by The Center or our website for useful resources: https://www.egr.msu.edu/careers/
☐ Participate in a Mock Interview- Sign up on Handshake
☐ Attend ASK sessions, Workshops, Company Presentations, etc.
☐ Have an internship or co-op for Spring or Summer semester? Enroll in EGR 393

Connect

☐ Attend Diversity Career Fair (January)
☐ Attend Engineering Expo (February 22)
☐ Attend the Spring Break corporate tour- Location revealed Fall 2017
☐ Build your LinkedIn profile
Login to Handshake. You will receive an email from us with a link to join Handshake. If you don’t have that email, simply go to: MSU.joinhandshake.com. Click the ‘Sign up for an Account’ link in the lower left hand corner to get started.

Explore majors and career paths
Sign up for workshops and events
Learn about career fairs
Connect with employers
Find job and internship opportunities
Search career resources

All Jobs (part-time, on and off-campus, full-time and internships), Career Fairs, Employer Events, and Off-Campus Career Events, will be posted on Handshake.

5 steps to get started with Handshake

Login to Handshake. You will receive an email from us with a link to join Handshake. If you don’t have that email, simply go to: MSU.joinhandshake.com. Click the ‘Sign up for an Account’ link in the lower left hand corner to get started.

Fill out your profile. Some of your information will already be in your Handshake profile. Check to be sure all this information is correct, fill out the remainder of your profile, and complete the Career Interest Questionnaire.

Upload a Document. You’ll likely want to have a public resume available in Handshake for employers to see. This will also help you complete your Handshake profile.

Take Handshake for a spin. Use the top search bar and filters to look for companies and jobs you’re interested in learning more about or applying to. You can always save your searches in Handshake, so finding relevant employers and jobs will be easy!

Favorite jobs and employers you’re interested in. When you follow an employer or a job, you’ll automatically start receiving information about the company or job so you won’t miss out on updates or new opportunities!

Note: Google Chrome is the recommended browser

We're Here to Help!
The Center (located in 1340 EB) offers walk-in advising to answer all career related questions and to help you get started with Handshake.

The Center, 1340 EB
(517) 355 5163
careers@egr.msu.edu

Take Handshake with you by downloading the Handshake Mobile App! only available for iphone
**What are the engineering disciplines?**

**Applied Engineering Sciences (AES) ~ https://www.egr.msu.edu/aes/**  
Broad foundation across all engineering majors; students choose business law, computer science, packaging, supply chain management, technical sales or media and information concentrations  
Work in: EGR consulting, recruiting, sales, marketing, logistics management

**Biosystems Engineering (BE) ~ https://www.egr.msu.edu/abe/**  
Broad biological component, food processing & ecosystems  
Work in: food quality & safety, renewable bioenergy, consulting and regulatory agencies

**Chemical Engineering (ChE) ~ http://www.chems.msu.edu/**  
Chemistry & engineering applied to full-scale industrial production  
Work in: pharmaceuticals, bioenergy, consumer products

**Civil Engineering (CE) ~ http://www.egr.msu.edu/cee/**  
Transportation, structures, infrastructure design and management  
Work with: roads, bridges, water, structures, construction, & infrastructure

**Computer Engineering (CpE) ~ http://www.egr.msu.edu/ece/**  
Hardware & software; make computers smaller & faster  
Work as: computer & embedded systems architects, real-time system design

**Computer Science (CpS) ~ http://www.cse.msu.edu/**  
Software design & development; databases, graphics, webpages, & networks  
Work in: cyber security, artificial intelligence, information technology, consulting, project management, & marketing

**Electrical Engineering (EE) ~ http://www.egr.msu.edu/ece/**  
Integrated circuits, robotics & control, power, lasers, & materials  
Work in: nanotechnology, fiber optic communication systems, automotive & aerospace industries

**Environmental Engineering (ENE) ~ http://www.egr.msu.edu/cee**  
Water and wastewater treatment, air quality, landfills and solid waste, permitting and regulation, hazardous waste cleanup, and protection of the environment  
Work in: consulting, government agencies, and industry

**Materials Science & Engineering (MSE) ~ http://www.chems.msu.edu/**  
Develop new materials & the processes to create them  
Work with: metals & ceramics, plastics, & polymers (non-metals)

**Mechanical Engineering (ME) ~ http://www.egr.msu.edu/me/**  
Anything with motion or moving parts, design  
Work in: aerospace, automotive, manufacturing, & energy systems
The information listed here is current as of Fall 2017. Students are expected to know departmental policies and course prerequisites and are ultimately responsible for accurately completing degree requirements.

The most current information on major requirements is available at http://www.egr.msu.edu/undergraduate/academics/programs
Applied Engineering Sciences

1. University Requirements: (23-24)
   Writing, Rhetoric and American Cultures (WRA) 4
   Integrative Studies in Humanities (IAH) 8
   IAH 201-210 and IAH 211 or > 8
   Integrative Studies in Social Sciences (ISS) 8
   ISS 2XX and ISS 3XX
   Bioscience (one of the following):
      BS 161, ENT 205, IBIO 150, MMG 141
      MMG 201, PLB 105, PSL 250 3-4

2. College Requirements: (30)
   *CEM 141 General 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: (61-64)
   a. Complete all of the following courses: (43)
      ACC 230 Survey of Accounting Concepts 3
      CE 221 Statics 3
      CEM 161 Chemistry Laboratory I 1
      EC 201 Introduction to Microeconomics 3
      EC 202 Introduction to Macroeconomics 3
      ECE 201 Circuits and Systems I 3
      ENE 280 Principles of Environ Engr & Science 3
      AESC 210 Global Sys: Econ, Engr, Environment 3
      AESC 310 Sustainable Systems Analysis 3
      AESC 410 Capstone Project in Applied Egr Sci(W) 3
      ME 201 Thermodynamics 3
      ME 280 Graphic Communications 2
      MKT 317 Quantitative Bus Research Methods 3
      MSE 250 Materials Science and Engineering 3
      PHY 191 Physics Lab for Scientists, I 1
      STT 315 Intro to Prob & Statistics for Business 3

   b. Select one of the following courses: (3)
      COM 225 Intro to Interpersonal Communication 3
      MGT 325 Management Skills and Processes 3

   c. Concentrations: (15-18)
      In consultation with their academic advisor, students must select one of the following concentrations: business law, computer science, packaging, supply chain management, technical sales, or media and information. For students interested in computer science, the minimum criteria for acceptance is the completion of Computer Science and Engineering 231 and 260 with a combined grade-point average in those two courses of 3.0. The concentration will be noted on the student’s academic record.

   Business Law: (16-17)
      1. All of the following courses: (13)
         EC 301 Intermediate Microeconomics 3
         EC 425 Law and Economics (W) 3
         GBL 295 Business Law, Public Policy & Ethics 3
         GBL 480 Environmental Law & Sustainability for Business: From Local to Global 3
         PHY 192 Physics Laboratory for Scientists, II 1

      2. One of the following courses: (3-4)
         PHL 345 Business Ethics 4
         PHL 354 Philosophy of Law 3
         PLS 320 Judicial Politics 3
         PLS 321 Constitutional Law 3
         PLS 322 Comparative Legal Systems 3

   Computer Science: (18)
      1. All of the following courses: (12)
         CSE 231 Introduction to Programming I 4
         CSE 232 Introduction to Programming II 4
         CSE 260 Discrete Structures in Computer Sci 4

      2. One of the following courses: (3)
         CSE 320 Computer Organization & Architecture 3
         CSE 331 Algorithms and Data Structures 3
         CSE 335 Object-oriented Software Design 4

      3. One of the following courses: (3)
         CSE 410 Operating Systems 3
         CSE 420 Computer Architecture 3
         CSE 440 Intro to Artificial Intelligence 3
         CSE 471 Media Processing & Multimedia Computing 3
         CSE 472 Computer Graphics 3
         CSE 476 Mobile Application Development 3
         CSE 477 Web Application Architecture and Development 3
         CSE 480 Database Systems 3
         CSE 482 Big Data Analysis 3
<table>
<thead>
<tr>
<th>Media and Information: (18)</th>
<th>Packaging: (17)</th>
<th>Technical Sales: (18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI 101 Understanding Media and Information 3</td>
<td>CEM 143 Survey of Organic Chemistry 4</td>
<td>COM 360 Advanced Sales Communication 3</td>
</tr>
<tr>
<td>MI 201 Media &amp; Information Technologies &amp; Industries 3</td>
<td>PKG 101 Principles of Packaging 3</td>
<td>**COM 483 Practicum in Sales Communication 1</td>
</tr>
<tr>
<td>MI 302 Networks, Markets and Society 3</td>
<td>PKG 221 Packaging with Glass and Metal 2</td>
<td>FI 320 Introduction to Finance 3</td>
</tr>
<tr>
<td>MI 305 Media and Information Policy 3</td>
<td>PKG 322 Packaging with Paper and Paperboard 4</td>
<td>MKT 313 Personal Selling and Buying Processes 3</td>
</tr>
<tr>
<td>MI 361 IT Network Management &amp; Security 3</td>
<td>PKG 323 Packaging with Plastics 4</td>
<td>MKT 327 Introduction to Marketing 3</td>
</tr>
<tr>
<td>MI 488 Information &amp; Communication Technology 3</td>
<td></td>
<td>MKT 383 Sales Management 3</td>
</tr>
<tr>
<td></td>
<td>Development Project (W)</td>
<td>SCM 474 Negotiations 2</td>
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</tbody>
</table>

### Supply Chain Management: (15)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI 320</td>
<td>Introduction to Finance</td>
<td>3</td>
</tr>
<tr>
<td>MKT 327</td>
<td>Introduction to Marketing</td>
<td>3</td>
</tr>
<tr>
<td>SCM 303</td>
<td>Introduction to Supply Chain Mgt</td>
<td>3</td>
</tr>
<tr>
<td>SCM 371</td>
<td>Procurement &amp; Supply Management</td>
<td>3</td>
</tr>
<tr>
<td>SCM 372</td>
<td>Manufacturing Planning and Control</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Suggested Elective SCM 373

### Packaging: (17)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 143</td>
<td>Survey of Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>PKG 101</td>
<td>Principles of Packaging</td>
<td>3</td>
</tr>
<tr>
<td>PKG 221</td>
<td>Packaging with Glass and Metal</td>
<td>2</td>
</tr>
<tr>
<td>PKG 322</td>
<td>Packaging with Paper and Paperboard</td>
<td>4</td>
</tr>
<tr>
<td>PKG 323</td>
<td>Packaging with Plastics</td>
<td>4</td>
</tr>
</tbody>
</table>

### Technical Sales: (18)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM 360</td>
<td>Advanced Sales Communication</td>
<td>3</td>
</tr>
<tr>
<td>**COM 483</td>
<td>Practicum in Sales Communication 1</td>
<td></td>
</tr>
<tr>
<td>FI 320</td>
<td>Introduction to Finance</td>
<td>3</td>
</tr>
<tr>
<td>MKT 313</td>
<td>Personal Selling and Buying Processes</td>
<td>3</td>
</tr>
<tr>
<td>MKT 327</td>
<td>Introduction to Marketing</td>
<td>3</td>
</tr>
<tr>
<td>MKT 383</td>
<td>Sales Management</td>
<td>3</td>
</tr>
<tr>
<td>SCM 474</td>
<td>Negotiations</td>
<td>2</td>
</tr>
</tbody>
</table>

**Requires a sales-based internship**

### Other Electives (Variable)

Total Credits Required for Degree 120

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The requirements listed above apply to students admitted to the major of Applied Engineering Sciences in the Engineering Undergraduate Studies Office (UGS) beginning Fall, 2017. The Engineering Undergraduate Studies Office constantly reviews 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 and appropriate schedule of courses. Students who have questions about Applied Engineering Sciences should contact the Engineering Undergraduate Studies Advising Office, 3508 Engineering Building, phone (517) 432-1352.

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NOTES:
Applied Engineering Sciences
Prerequisite Flowchart

These requirements are effective for students admitted to the Applied Engineering Sciences major beginning Fall 2017.

FRESHMAN YEAR

FALL Term 1
CEM 161 - 1
Com Lab I

SPRING Term 2

PHYSICS I

SOPHOMORE YEAR

FALL Term 3
PHY 184 - 4
Physics II

SPRING Term 4
ACC 230 - 3
Survey of Accounting

JUNIOR YEAR

FALL Term 5
ME 201 - 3
Thermodynamics

SPRING Term 6
MSE 250 - 3
Matls Sci & Engr

Senior Year

FALL Term 7

SPRING Term 8

Concentration 3 credits

Legend:

- Prerequisite
- Prerequisite or Concurrent

Rounded box: Offered only in the semester listed (excluding summer)

*DIV: Complete courses in at least 2 out of 3 diversity categories—'N', 'I' or 'D'

Last Revised: 02/21/17
Michigan State University | College of Engineering | Engineering Undergraduate Studies
Engineering Building, 428 S. Shaw Lane, Room 1415, East Lansing MI 48824 | (517) 355-6616
http://www.egr.msu.edu/undergraduate/academic/degree-programs

**Biosystems Engineering**

Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

1. University Requirements: (23)
   - Writing, Rhetoric and American Cultures (WRA) 4
   - Integrative Studies in Humanities, IAH 201-210 and IAH 211 or > 8
   - Integrative Studies in Social Sciences, ISS 2XX and ISS 3XX 8
   - Bioscience: BS 161 Cell and Molecular Biology 3

2. College Requirements: (30) *College Admission Requirement
   - CEM 141 General 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: (64-66)
   a. Complete all of the following courses: (44)
      - BE 101 Introduction to Biosystems Engineering 1
      - BE 230 Engineering Analysis of Biological Systems 3
      - BE 332 Engineering Properties of Biological Materials 3
      - BE 334 Biosystems Engineering Laboratory Practice 3
      - BE 350 Heat and Mass Transfer in Biosystems 3
      - BE 351 Thermodynamics for Biological Engineering 3
      - BE 360 Microbial Systems Engineering 3
      - BE 385 Engineering Design & Optimization for Biological Sys 3
      - BE 485 Biosystems Design Techniques 3
      - BE 487 Biosystems Design Project (W) 3
      - BS 162 Organismal and Population Biology 3
      - CE 221 Statics 3
      - CE 274 Graphics for Civil & Environmental Engineers 1
      - CE 321 Introduction to Fluid Mechanics 4
      - CEM 143 Survey of Organic Chemistry 4
      - CEM 161 Chemistry Laboratory I 1
      - CHE 468 Biomass Conversion Engineering 3
      - CSS 467 Bioenergy Feedstock Production 3
   b. Select one of the following courses: (2)
      - BS 171 Cell and Molecular Biology Laboratory 2
      - BS 172 Organismal and Population Biology Laboratory 2
   c. Select one of the following courses: (3-4)
      - IBIO 341 Fundamental Genetics 4
      - IBIO 355 Ecology 3
      - MMG 301 Introductory Microbiology 3
      - PLB 301 Introductory Plant Physiology 3
      - PSL 250 Introductory Physiology 4
   d. Select one of the following courses: (3-4)
      - BLD 450 Eukaryotic Pathogens 3
      - CSS 442 Agricultural Ecology 3
      - CSS 451 Biotechnology Apps for Breeding & Genetics 3
      - FOR 406 Applied Forest Ecology; Silviculture 3
      - FSC 440 Food Microbiology 3
      - MMG 425 Microbial Ecology 3
      - MMG 445 Microbial Biotechnology (W) 3
      - PLB 402 Biology of Fungi 4
      - PLB 424 Algal Biology 4
      - PSL 425 Physiological Biophysics 3
   e. Select four of the following courses: (12)
      - BE 444 Biosensors for Medical Diagnostics 3
      - BE 449 Human Health Risk Analysis for Eng Controls 3
      - BE 456 Electric Power and Control 3
      - BE 469 Sustainable Bioenergy Systems 3
      - BE 477 Food Engineering: Fluids 3
      - BE 478 Food Engineering: Solids 3
      - BE 481 Water Resources Sys Anlys & Modeling 3
      - BE 482 Diffuse-Source Pollution Engineering 3
      - CHE 468 Biomass Conversion Engineering 3

**Optional Concentrations**

The department offers concentrations for students who wish to focus on a specific application area in the discipline. The concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree program in Biosystems Engineering. Courses completed to satisfy requirement 3. above may also be used to satisfy the requirements of a concentration. The concentration will be noted on the student’s transcript.

**Bioenergy and Bioproduct Engineering Concentration:** (15-17)

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

1. All of the following courses: (9)
   - BE 469 Sustainable Bioenergy Systems 3
   - CHE 468 Biomass Conversion Engineering 3
   - CSS 467 Bioenergy Feedstock Production 3

2. Two of the following courses: (6-8):
   - BE 457 Bioenergy Feedstock Systems Analysis 3
   - CHE 481 Biochemical Engineering 3
   - CHE 882 Advanced Biochemical Engineering 3
   - CHE 883 Multidisciplinary Bioprocessing Laboratory 3
   - CSS 451 Biotechnology Applications for Plant Breeding & Genetics 3
   - FOR 406 Applied Forest Ecology: Silviculture 3
   - GLG 471 Applied Geophysics 4
   - MC 450 International Environmental Law & Policy 3
   - ME 417 Design of Alternative Energy Systems 3
   - ME 422 Introduction to Combustion 3
   - MMG 445 Microbial Biotechnology (W) 3
   - PLB 402 Biology of Fungi 4
   - PLB 424 Algal Biology 4
**Biosystems Engineering**

**Biomedical Engineering Concentration: (14-15)**
To earn a Bachelor of Science degree in Biosystems Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., and 3. above and the following:

1. All of the following courses: (6)
   - BE 444 Biosensors for Medical Diagnostics 3
   - BE 449 Human Health Risk Analysis for Eng Controls 3

2. One of the following courses: (3)
   - BLD 450 Eukaryotic Pathogens 3
   - PSL 425 Physiological Biophysics 3

3. Two of the following: (5-6)
   - BLD 204 Mechanisms of Disease 3
   - BLD 430 Molecular Laboratory Diagnostics 3
   - BLD 434 Clinical Immunology 3
   - BLD 450 Eukaryotic Pathogens 3
   - ECE 445 Biomedical Instrumentation 3
   - ME 494 Biofluid Mechanics and Heat Transfer 3
   - MSE 425 Biomaterials and Biocompatibility 3
   - PLB 400 Introduction to Bioinformatics 3
   - PSL 425 Physiological Biophysics 3

Courses used to fulfill requirement 2. in this concentration may not be used to fulfill this requirement.

**Ecosystems Engineering Concentration: (14-15)**
To earn a Bachelor of Science degree in Biosystems Engineering with an ecosystems engineering concentration, students must complete requirements 1., 2., and 3. above and the following:

1. All of the following courses: (9)
   - BE 481 Water Resources Systems Analysis and Modeling 3
   - BE 482 Diffuse-Source Pollution Engineering 3
   - MMG 425 Microbial Ecology 3

2. Two of the following courses: (5-6)
   - CE 422 Applied Hydraulics 3
   - CSS 210 Fundamentals of Soil Science 3
   - CSS 330 Soil Chemistry 2
   - CSS 360 Soil Biology 3
   - CSS 442 Agricultural Ecology 3
   - CSS 455 Pollutants in the Soil Environment 3
   - FOR 404 Forest Ecology 3
   - FW 417 Wetland Ecology and Management 3
   - FW 420 Stream Ecology 3
   - FW 443 Restoration Ecology 3

**Food Engineering Concentration: (15-16)**
To earn a Bachelor of Science degree in Biosystems Engineering with a food engineering concentration, students must complete requirements 1., 2., and 3. above and the following:

1. All of the following courses: (9)
   - BE 477 Food Engineering: Fluids 3
   - BE 478 Food Engineering: Solids 3
   - FSC 440 Food Microbiology 3

2. Two of the following courses, one of which must be at the 400-level: (6-7)
   - BMB 200 Introduction to Biochemistry 4
   - FSC 211 Principles of Food Science 3
   - FSC 401 Food Chemistry 3
   - FSC 430 Food Processing: Fruits & Vegetables 3
   - FSC 431 Food Processing: Cereals 3
   - FSC 432 Food Processing: Dairy Foods 3
   - FSC 433 Food Processing: Muscle Foods 3

**Other Electives (Variable)**

**Total Credits Required for Degree** 128

These requirements are effective for students admitted to the Biosystems Engineering major beginning Fall 2016. The Department of Biosystems and Agricultural Engineering (BAE) 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 Biosystems Engineering should contact the Biosystems Engineering Advising Office, 103 B Farrall Hall, phone (517) 884-8796. For scheduling academic advising appointments visit: https://msu.campus.eab.com

_Last revised May 2017._
Biosystems Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Biosystems Engineering major beginning Fall 2016.

LEGEND

- Prerequisite
- Prerequisite or Concurrent
- Corequisite

Rounded box: Offered only in the semester listed (excluding summer) *Div: Complete courses in at least 2 out of 3 diversity categories “N”, “I” or “D”

Last Revised: 02/23/17
### Chemical Engineering

Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

1. **University Requirements:** (23)
   - Writing, Rhetoric and American Cultures (WRA) 4
   - Integrative Studies in Humanities (IAH) 8
   - ISS201-210 and ISS 211 or >
   - Integrative Studies in Social Sciences (ISS) 8
   - ISS 2XX and ISS 3XX
   - Biosciences: 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.

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.*

   - **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](#)

       - **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 Biochemical Engineering 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 Concentration: (15)

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., 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)
- CSUS 465 Environmental and Natural Resource Law 3
- EEP 255 Ecological Economics 3
- EEP 320 Environmental Economics 3
- EEP 405 Corporate Environmental Management (W) 3
- ENE 481 Environmental Chemistry: Equilibrium Concepts 3
- ENE483 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  
- CHE 472  Composite Materials Processing  
- ME 222  Mechanics of Deformable Solids

Two of the following courses:  (6-7)
- CHE 871  Materials Surfaces and Interfaces  
- CHE 872  Polymers & Composites: Mfg, Strc & Prfrmnce  
- MSE 370  Synthesis and Processing of Materials  
- MSE 426  Introduction to Composite Materials  
- PKG 323  Packaging with Plastics

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 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.
Chemical Engineering
Prerequisite Flowchart

These requirements are effective for students admitted to the Chemical Engineering major beginning Fall 2017.

FALL Term 1
- CEM 161 - 1 Cem Lab I
- CEM 162 - 1 CemLab II
- CEM 151 - 4 Gen Cem
- EGR 100 - 2 Intro Engr Desgn
- MTH 132 - 3 Calc I
- ISS 2XX – 4 *Div- N, I or D
- WRA 101 - 4 Univ Writing

SPRING Term 2
- CEM 152 - 3 Principls of Cem
- EGR 102 - 2 Intro Engr Model
- CHE 201 - 3 Matl & Energy Bal
- Elective - 1 1 crs of Gen Elecs
- MTH 133 - 4 Calc II
- PHY 183 - 4 Physics I

FALL Term 3
- BS 161 - 3 Cells & Molecular Biology
- Elective - 2 2 crs of Gen Elecs
- PHY 184 - 4 Physics II
- CHE 210 - 3 Mod Trans Phen
- MTH 234 - 4 Multivar Calc
- CHE 472 - 3 Comp Mats Proc (P: CHE 311) OR

SPRING Term 4
- CEM 351 - 3 Organic Cem I
- CEM 352 - 3 Organic Cem I
- CEM 355 - 2 Organic Lab I
- CHE 311 - 3 Fluid Flow & Heat Transfer
- CHE 316 - 4 Lab Prac & Stat Analysis
- CHE 312 - 4 Mass Trns & Sep
- CHE 432 - 3 Process Control
- CHE 433 - 4 Proc Dsgn & Opt I
- Technical Elec - 3
- CHE 434 - 2 Proc Dsgn & Opt II
- Technical Elec - 3
- Elective - 3 3 crs of Gen Elecs

FALL Term 5
- CHE 321 - 4 Thermodynamics for Chem Engr
- CHE 310 - 4 Cem Reac Engr
- Elective - 2 2 crs of Gen Elecs
- IAH 201-210 - 4 *Div- N, I or D
- ISS 3XX - 4 *Div- N, I or D
- IAH 211 or > - 4 *Div- N, I or D

SPRING Term 6
- CHE 320 - 4 Cem Engr Princ P & M
- CHE 331 - 3 Chem Engr Prof
- Elective - 1 1 crs of Gen Elecs
- Elective - 1 1 crs of Gen Elecs
- Elective - 1 1 crs of Gen Elecs

FALL Term 7
- CHE 332 - 4 Chem Engr Prof
- Elective - 2 2 crs of Gen Elecs
- Elective - 1 1 crs of Gen Elecs
- Elective - 1 1 crs of Gen Elecs
- Elective - 1 1 crs of Gen Elecs

SPRING Term 8
- CHE 473 - 3 Chem Engr Princ P & M
- CHE 474 - 3 Chem Engr Princ P & M
- CHE 475 - 3 Chem Engr Princ P & M
- Elective - 3 3 crs of Gen Elecs
- Elective - 3 3 crs of Gen Elecs
- Elective - 3 3 crs of Gen Elecs

LEGEND
- Prerequisite
- Prerequisite or Concurrent
- "P:" Prerequisite
- "Div-" Complete courses in at least 2 out of 3 diversity categories - "N", "I" or "D"

Last Revised: 02/23/17
Civil Engineering

Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

1. University Requirements: (23-24)
   Writing, Rhetoric and American Cultures (WRA) 4
   Integrative Studies in Humanities, IAH 201-210 & IAH 211 or > 8
   Integrative Studies in Social Sciences, ISS 2XX & ISS 3XX 8
   Bioscience (one of the following): 3-4
      BS 161, ENT 205, IBIO 150, MMG 141,
      MMG 201, PLB 105, PSL 250

2. College Requirements: (30)
   *CEM 141 General Chemistry 4
   OR
   *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)
   a. Complete all of the following courses: (43)
      CE 221 Statics 3
      CE 273 Civil & Environmental Engineering Measurements 2
      CE 274 Graphics for Civil & Environmental Engineers 1
      CE 305 Introduction to Structural Analysis 3
      CE 312 Soil Mechanics 4
      CE 321 Introduction to Fluid Mechanics (W) 4
      CE 337 Civil Engineering Materials 4
      CE 341 Transportation Engineering (W) 3
      CE 371 Sustainable Civil & Environmental Egr Systems 3
      CE 372 Risk Analysis in Civil & Environmental Engineering 2
      CE 495 Senior Design in Civil & Environmental Engineering 4
      CEM 161 Chemistry Laboratory I 1
      ENE 280 Principles of Environmental Engineering & Science 3
      GLG 301 Geology of Continents and Oceans 3
      ME 222 Mechanics of Deformable Solids 3
   b. Complete one of the following courses: (3)
      CE 461 Computational Methods in Civil Engineering 3
      ME 361 Dynamics 3
   c. Complete one of the following courses: (3)
      BE 351 Thermodynamics for Biological Engineering 3
      ECE 345 Electronic Instrumentation and Systems 3
      ME 201 Thermodynamics 3
      MSE 250 Materials Science and Engineering 3
   d. Design-Intensive Electives: (12)
      Complete 12 credits of electives from the list below from at least four different areas (environmental, geotechnical, pavements, structures, transportation, and water resources).
      Environmental
      ENE 483 Water & Wastewater Engineering 3
      ENE 489 Air Pollution: Science & Engineering 3
      Geotechnical
      CE 418 Geotechnical Engineering 3
      Pavements
      CE 431 Pavement Design and Analysis I 3
      Structures
      CE 405 Design of Steel Structures 3
      CE 406 Design of Concrete Structures 3
      Transportation
      CE 444 Principles of Traffic Engineering 3
      CE 449 Highway Design 3
      Water Resources
      ENE 421 Engineering Hydrology 3
      ENE 422 Applied Hydraulics 3
   e. Technical Electives: (6) Complete six additional credits, courses may include those on above list and
      ENE 481 Environmental Chem: Equilibrium Concepts 3
      ENE 487 Microbiology for Environmental Sci & Eng 3
      CE 400 Structural Mechanics 3
      CE 407 Materials Eng: Properties, Selection & Processing 3
      CE 432 Pavement Rehabilitation 3
      CE 448 Transportation Planning 3
      CE 471 Construction Eng-Eqpt, Methods & Planning 3
   Other Electives (Variable)

Total Credits Required for Degree 128

The requirements listed above apply to students admitted to the Department of Civil & Environmental Engineering (CEE) beginning Fall 2017. The Department of Civil & Environmental Engineering (CEE) 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 Civil Engineering should contact the Civil & Environmental Engineering Department Advising Office, 3579 Engineering Building, phone (517) 355-3274. For scheduling academic advising appointments https://msu.campus.eab.com

Last Revised May 2017
Civil Engineering
Prerequisite Flowchart

These requirements are effective for students admitted to the Civil Engineering major beginning Fall 2017.

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>FALL Term 1</th>
<th>SPRING Term 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 161 - 1 Cem Lab I</td>
<td>CEM 141 OR CEM 151 - 4 Gen Cern</td>
</tr>
<tr>
<td>EGR 100 - 2 Intro Engr Design</td>
<td>EGR 102 - 2 Intro Engr Model</td>
</tr>
<tr>
<td>MTH 132 - 3 Calc I</td>
<td>MTH 133 - 4 Calc II</td>
</tr>
<tr>
<td>MTH 234 - 4 MultivarCalc</td>
<td>ME 222 - 3 Mech of Defrm Sci</td>
</tr>
<tr>
<td>CE 274 - 1 Graphics</td>
<td>ME 222 - 3 Mech of Defrm Sci</td>
</tr>
<tr>
<td>ENE 280 - 3 Prm of Env Engr and Sci</td>
<td>ME 222 - 3 Mech of Defrm Sci</td>
</tr>
<tr>
<td>MTH 133 - 4 Calc II</td>
<td>MTH 234 - 3 Diff Equations</td>
</tr>
<tr>
<td>MTH 235 - 3 Diff Equations</td>
<td>MTH 234 - 3 Diff Equations</td>
</tr>
<tr>
<td>CE 221 - 3 Statics</td>
<td>GLG 301 - 3 Geo of the Great Lakes Region</td>
</tr>
</tbody>
</table>

LEGEND
- Prerequisite
- Prerequisite or Concurrent
- *Div- Complete courses in at least 2 out of 3 diversity categories: "N", "I" or "D"

Rounded box: Offered only in the semester listed (excluding summer)
1. University Requirements: (23-24)
   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 (one of the following):
   BS 161, ENT 205, IBIO 150, MMG 141,
   MMG 201, PLB 105, PSL 250 3-4

2. College Requirements: (32)
   *CEM 141 General Chemistry 4
   *CSE 231 Introduction to Programming I 4
   *EGR 100 Introduction to Engineering Design 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: (65)

   a. Complete one of the following courses: (1)
      CEM 161 Chemistry Laboratory I 1
      PHY 191 Physics Laboratory for Scientists I 1

   b. All of the following courses: (40)
      CSE 232 Introduction to Programming II 4
      CSE 260 Discrete Structures in Computer Sci 4
      CSE 331 Algorithms and Data Structures 3
      CSE 410 Operating Systems 3
      ECE 201 Circuits and Systems I 3
      ECE 206 Circuits and Systems II 3
      ECE 203 Electronic Circuits and Systems Lab 1
      ECE 230 Digital Logic Fundamentals 3
      ECE 280 Electrical Engineering Analysis 3
      ECE 302 Electronic Circuits 3
      ECE 303 Electronics Laboratory 1
      ECE 331 Microprocessors & Digital Systems 4
      ECE 390 Ethics, Professionalism and 1
      Contemporary Issues
      ECE 480 Senior Design (W) 4

   c. Electives: (24)
      Complete 24 credits of electives as specified below. At least 18
      credits must be from core and focus track electives combined,
      with at least one course with a laboratory. Additional credits to
      meet the 24 credit requirement may be taken from other courses
      listed below, any 400-level Computer Science and Engineering
      (CSE) or Electrical and Computer Engineering (ECE) courses,
      or by completing an approved 3 or 4 credit experiential, out-of-
      classroom education experience obtained through engineering
      cooperative education or independent study.

1. Core: (6)
   At least 6 credits from the following:
   CSE 420 Computer Architecture 3
   CSE 422 Computer Networks 3
   or
   ECE 442 Introduction to Communication Networks 3
   ECE 410 VLSI Design (L) 4
   Both CSE 422 and ECE 442 may not be used to fulfill this requirement

2. At least 3 credits from the following: (3)
   ECE 305 Electromagnetic Fields and Waves I 4
   ECE 313 Control Systems 3
   ECE 366 Introduction to Signal Processing 3

Focus Track: (9)
   At least 9 credits from the following:

Hardware
   ECE 402 App of Analog Integrated Circuits (L) 4
   ECE 411 Electronic Design Automation (L) 4
   ECE 412 Intro to Mixed-Signal Circuits Design (L) 4
   ECE 445 Biomedical Instrumentation 3

Software
   CSE 335 Object-oriented Software Design 4
   CSE 450 Translation of Programming Languages 3
   CSE 471 Media Processing & Multimedia Computing 3
   ECE 366 Introduction to Signal Processing 3

Recommended Electives:
   ECE 305 Electromagnetic Fields & Waves I 4
   ECE 313 Control Systems 3
   ECE 404 Radio Frequency Electronic Circuits 4
   ECE 415 Computer Aided Manufacturing 3
   ECE 416 Digital Control 3
   ECE 456 Intro to Communication & Network Security 3
   ECE 457 Communication Systems 3
   ECE 458 Communication Systems Laboratory 1
   ECE 466 Digital Signal Processing & Filter Design 3
   ECE 474 Principles of Electronics Devices 3

Other Electives (Variable)

Total Credits Required for Degree 128

The requirements listed above apply to students admitted to
the major of Computer Engineering beginning Fall, 2017. The
Department of Electrical and Computer Engineering (ECE)
constantly reviews program requirements and reserves the
right to make changes as necessary. Students are
encouraged to consult with their advisor to obtain assistance
in planning an appropriate schedule. Students who have
questions about Computer Engineering should contact the
Electrical and Computer Engineering Department Advising
Office, 2212 Engineering Building, phone (517) 355-5242.

Last revised May 2017
**NOTES:**

**Biomedical Engineering Concentration: (15)**

The department offers a concentration for students who plan to pursue graduate work in biomedical areas or seek employment in selected medical-related areas. The concentration is available to, but not required of, any student enrolled in the Bachelor of Science degree program in Computer Engineering. Courses completed to satisfy requirement 3. above may also be used to satisfy the requirements of the concentration. The concentration will be noted on the student’s transcript.

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

**1. Complete 6 credits from the following courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTR 350</td>
<td>Human Gross Anatomy for Pre-Health Professionals</td>
<td>3</td>
</tr>
<tr>
<td>BS 161</td>
<td>Cell and Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>PSL 250</td>
<td>Introductory Physiology</td>
<td>4</td>
</tr>
<tr>
<td>PSL 310</td>
<td>Physiology for Pre-Health Professionals</td>
<td>4</td>
</tr>
</tbody>
</table>

**2. Complete 6 credits from the following courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 445</td>
<td>Biomedical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 446</td>
<td>Biomedical Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 447</td>
<td>Introduction to Biomedical Imaging</td>
<td>3</td>
</tr>
<tr>
<td>ECE 448</td>
<td>Modeling and Analysis of Bioelectrical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 449</td>
<td>Fundamentals of Acoustics</td>
<td>3</td>
</tr>
</tbody>
</table>

**3. Complete 3 credits from the following courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 444</td>
<td>Biosensors for Medical Diagnostics</td>
<td>3</td>
</tr>
<tr>
<td>ME 494</td>
<td>Biofluid Mechanics and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 495</td>
<td>Tissue Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MSE 425</td>
<td>Biomaterials and Biocompatibility</td>
<td>3</td>
</tr>
</tbody>
</table>

A 400-level listed above or other approved Electrical and Computer Engineering (ECE) courses with biomedical engineering content as approved by the student’s advisor. The course used to fulfill this requirement may not be used to fulfill concentration requirement 1. or 2.
Computer Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Computer Engineering major beginning Fall 2017.

FRESHMAN YEAR

FALL Term 1
- Bioscience - 3/4
  Choose 1 from approved list
- CEM 141 - 4
  Gen Cem

SPRING Term 2
- EGR 100 - 2
  Intro Engr Design
- MTH 132 - 3
  Calc I
- PHY 183 - 4
  Physics I

- MTH 133 - 4
  Calc II
- PHY 184 - 4
  Physics II
- WRA 101 - 4
  Univ Writing
- ISS 2XX - 4
  *Div- N, I or D

SOPHOMORE YEAR

FALL Term 3
- CSE 231 - 4
  Intro to Progr I
- CEM 161 - 1
  CemLab 1
  (P: CEM 141)
  OR
  PHY 191 - 1
  Physics Lab 1
  (P: PHY 183 or conc)
- ECE 201 - 3
  Circuits & Syst I
- ECE 202 - 3
  Circuits & Syst II
- MTH 234 - 4
  MultivarCalc
- MTH 235 - 3
  Diff Equations
- ECE 280 - 3
  Elec Engr Analy

- ECE 230 - 4
  Digital Logic Fund
- ECE 203 - 1
  Elec Cir & Sys Lab

- PHY 183 - 4
  Physics I

SPRING Term 4
- CSE 232 - 4
  Intro to Progr II
- ECE 202 - 3
  Circuits & Syst II
- ECE 203 - 1
  Elec Cir & Sys Lab
- ECE 205 - 3
  Digital Logic Fund
- ECE 280 - 3
  Elec Engr Analy

- ECE 280 - 3
  Elec Engr Analy

JUNIOR YEAR

FALL Term 5
- CSE 260 - 4
  Disc Str in Cmp Sc
- ECE 302 - 3
  Elec Circuits
- ECE 280 - 3
  Elec Engr Analy
- MTR 235 - 3
  Diff Equations

- CSE 260 - 4
  Disc Str in Cmp Sc
- ECE 302 - 3
  Elec Circuits
- ECE 280 - 3
  Elec Engr Analy
- MTR 235 - 3
  Diff Equations

SPRING Term 6
- CSE 260 - 4
  Disc Str in Cmp Sc
- ECE 302 - 3
  Elec Circuits
- ECE 280 - 3
  Elec Engr Analy
- MTR 235 - 3
  Diff Equations

- ECE 302 - 3
  Elec Circuits
- ECE 280 - 3
  Elec Engr Analy
- MTR 235 - 3
  Diff Equations

SENIOR YEAR

FALL Term 7
- CSE 410 - 3
  Operating Sysnms
- CSE 410 - 3
  Operating Sysnms
- MTR 235 - 3
  Diff Equations
- MTR 235 - 3
  Diff Equations
- MTR 235 - 3
  Diff Equations

SPRING Term 8
- Elective - Var
  X crs of Gen Elecs
- Core Elect #1 - 3/4
  Choose 1 from approved list
- Core Elect #2 - 3/4
  Choose 1 from approved list
- ECE 390 - 1
  Ethics, Prof & Cont
  Issues
- MTR Elect #3 - 3/4
  Choose 1 from approved list
- MTR Elect #4 - 3/4
  Choose 1 from approved list
- MTR Elect #5 - 3/4
  Choose 1 from approved list
- MTR Elect #6 - 3/4
  Choose 1 from approved list
- MTR Elect #6 - 3/4
  Choose 1 from approved list
- ISS 3XX - 4
  *Div- N, I or D
- ISS 3XX - 4
  *Div- N, I or D
- IAH 211 or > - 4
  *Div- N, I or D

LEGEND

- Prerequisite
- Prerequisite or Concurrent

Rounded box: Offered only in the semester listed (excluding summer)

"Div": Complete courses in at least 2 out of 3 diversity categories - "N", "I" or "D"

Last Revised 2/28/17
University Requirements

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

College Requirements:

Calculus I
Physics for Scientists & Engineers I
Calculus II

Major Requirements

Introduction to Engineering Design

Group 1

**BS 161  Cell and Molecular Biology  3
ENT 205  Pests, Society & Environment  3
IBIO 150  Integrating Biology: From DNA to Populations  3
MMG 141  Introductory Human Genetics  3
MMG 201  Fundamentals of Microbiology  3
PLB 105  Plant Biology  3
PSL 250  Introductory Physiology  4

Group 2

BS 171  Cell and Molecular Biology Laboratory  2
**CEM 161  Chemistry Laboratory I  1
CEM 162  Chemistry Laboratory II  1
PHY 191  Physics Laboratory for Scientists I  1
PHY 192  Physics Laboratory for Scientists II  1
PLB 106  Plant Biology Laboratory  1

b. Complete all of the following: (29)

CSE 100  Computer Science as a Profession  1
CSE 233  Introduction to Programming II  4
CSE 260  Discrete Structures in Computer Science  4
CSE 320  Computer Organization and Architecture  3
CSE 331  Algorithms and Data Structures  3
CSE 335  Object-Oriented Software Design  4
CSE 410  Operating Systems  3
CSE 498  Collaborative Design (W)  4
STT 351  Probability and Statistics for Engineering  3

Required Cognate: (15)

Cognates in the following areas are available to students in Computer Science: business, communication arts and sciences, foreign language, mathematics, the natural sciences, philosophy, psychology, the social sciences, and telecommunication. Students may complete cognates in other areas with the approval of the Department of Computer Science and Engineering academic adviser. The cognate should enhance the student’s ability to apply analytical procedures in a specific subject area.

The cognate is selected from (1), (2) or (3) below. The academic adviser of the Department of Computer Science and Engineering must pre-approve both the cognate and the cognate courses.

Cognate 1
A minimum of four courses totaling 15 or more credits outside the College of Engineering. At least 6 of the 15 credits must be in courses at the 300-400 level.

Cognate 2
Cognate in The Eli Broad College of Business consisting of this specific set of courses: ACC 230, (EC 201 or EC 202), FI 320, GBL 323 and MKT 327.

Cognate 3
A sequence of at least four courses in a foreign language.

Other Electives (Variable)

Total Credits Required for Degree 120

The requirements listed above apply to students admitted to the major of Computer Science in the Department of Computer Science and Engineering beginning Fall 2017. The Department of Computer Science and Engineering (CSE) 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 Computer Science should contact the Computer Science and Engineering Department Advising Office, 3201 Engineering Building, phone (517) 353-5455.
Computer Science
Requirements and Program Flow

These requirements are effective for students admitted to the Computer Science major beginning Fall 2017.
Electrical Engineering

Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

1. University Requirements: (23-24)
   - Writing, Rhetoric and American Cultures (WRA) 4
   - Integrative Studies in Humanities (IAH) 8
   - IAH 201-210 and IAH 211 or > 8
   - Integrative Studies in Social Sciences (ISS) 8
   - ISS 2XX and ISS 3XX 8

   Bioscience (one of the following):
   - BS 161, ENT 205, IBIO 150, MMG 141, MMG 201, PLB 105, PSL 250 3-4

2. College Requirements: (31)
   - *CEM 141 General Chemistry 4
   - *EGR 100 Introduction to Engineering Design 2
   - *CSE 220 Programming in C 3
   - *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: (61)
   a. Complete one of the following courses: (1)
      - CEM 161 Chemistry Laboratory I 1
      - PHY 191 Physics Laboratory for Scientists I 1
   b. Complete all of the following courses: (39)
      - ECE 201 Circuits and Systems I 3
      - ECE 202 Circuits and Systems II 3
      - ECE 203 Electronic Circuits and Systems Lab 1
      - ECE 230 Digital Logic Fundamentals 3
      - ECE 280 Electrical Engineering Analysis 3
      - ECE 302 Electronic Circuits 3
      - ECE 303 Electronics Laboratory 1
      - ECE 305 Electromagnetic Fields & Waves I 4
      - ECE 313 Control Systems 3
      - ECE 320 Energy Conversion & Pwr Electronics 3
      - ECE 331 Microprocessors & Digital Systems 4
      - ECE 366 Introduction to Signal Processing 3
      - ECE 390 Ethics, Professionalism and Contemporary Issues 1
      - ECE 480 Senior Design (W) 4
   c. Select one of the following courses: (3)
      - CE 221 Statics 3
      - ME 201 Thermodynamics 3
   d. Major Electives: (18)
      A minimum of six courses totaling a minimum of 18 credits, of 3- or 4-credits each, selected from at least four different areas. A laboratory course ("L") must be included. Students may substitute, for one of the six required courses, a 3- or 4-credit experiential education experience obtained in a minimum of three out-of-classroom experiences through engineering cooperative education or independent study. Students interested in the experiential education experience must contact the department for approval.

   Electromagnetics
   - ECE 405 Electromagnetic Fields and Waves II (L) 4
   - ECE 407 Electromagnetic Compatibility (L) 4

   Power
   - ECE 420 Machines and Power Laboratory 1
   - ECE 423 Power System Analysis 3
   - ECE 425 Solid State Power Conversion 3

   Integrated Circuits / VLSI
   - ECE 402 Applications of Analog Integrated Circuits (L) 4
   - ECE 404 Radio Frequency Electronic Circuits (L) 4
   - ECE 410 VLSI Design (L) 4
   - ECE 411 Electronic Design Automation (L) 4
   - ECE 412 Intro to Mixed-Signal Integrated Circuits (L) 4

   Solid-State Electronics / Electro-optics
   - ECE 474 Principles of Electronic Devices 3
   - ECE 476 Electro-Optics (L) 4
   - ECE 477 Microelectronic Fabrication (L) 3

   Communications / Signal Processing
   - ECE 442 Introduction to Communication Networks 3
   - ECE 456 Intro to Communication & Networks Security 3
   - ECE 457 Communication Systems 3
   - ECE 458 Communication Systems Laboratory 1
   - ECE 466 Digital Signal Processing and Filter Design 3

   Control / Robotics
   - ECE 415 Computer Aided Manufacturing (L) 3
   - ECE 416 Digital Control (L) 3

   Biomedical Engineering
   - ECE 445 Biomedical Instrumentation (L) 3
   - ECE 446 Biomedical Signal Processing 3
   - ECE 447 Intro to Biomedical Imaging 3
   - ECE 448 Modeling & Analy of Bioelectrical Systems 3
   - ECE 449 Fundamentals of Acoustics 3
Biomedical Engineering Concentration: (15)
The department offers a concentration for students who plan to pursue graduate work in biomedical areas or seek employment in selected medical-related areas. The concentration is available to, but not required of, any student enrolled in the Bachelor of Science degree program in Electrical Engineering. Courses completed to satisfy requirement 3. above may also be used to satisfy the requirements of the concentration. The concentration will be noted on the student's transcript.

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

1. Complete 6 credits from the following: (6)
   - ANTR 350 Human Gross Anatomy for Pre-Health Professionals 3
   - BS 161 Cells and Molecular Biology 3
   - PSL 250 Introductory Physiology 4
   - PSL 310 Physiology for Pre-Health Professionals 4

2. Complete 6 credits from the following: (6)
   - ECE 445 Biomedical Instrumentation 3
   - ECE 446 Biomedical Signal Processing 3
   - ECE 447 Intro to Biomedical Imaging 3
   - ECE 448 Modeling & Anlys of Bioelectrical Systems 3
   - ECE 449 Fundamentals of Acoustics 3

3. Complete 3 credits from the following: (3)
   - BE 444 Biosensors for Medical Diagnostics 3
   - ME 494 Biofluid Mechanics and Heat Transfer 3
   - ME 495 Tissue Mechanics 3
   - MSE 425 Biomaterials and Biocompatibility 3
   - A 400-level listed above or other approved Electrical and Computer Engineering (ECE) courses with biomedical engineering content as approved by the student's advisor. The course used to fulfill this requirement may not be used to fulfill concentration requirement 1. or 2.

Other Electives (Variable)

Total Credits Required for Degree 128

The requirements listed above apply to students admitted to the major of Electrical Engineering beginning Fall, 2017. The Department of Electrical and Computer Engineering (ECE) constantly reviews program requirements and reserves the right to make changes as necessary. Students are encouraged to consult with their advisor to obtain assistance in planning an appropriate schedule. Students who have questions about Computer Engineering should contact the Electrical and Computer Engineering Department Advising Office, 2212 Engineering Building, phone (517) 355-5242.
Electrical Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Electrical Engineering major beginning Fall 2017.

LEGEND

- P: Prerequisite
- C: Concurrent
- *Div: Complete courses in at least 2 out of 3 diversity categories – “N”, “I” or “D”

FRESHMAN YEAR

Fall Term 1
- Elective - 1/4

Spring Term 2
- Elective - 1/4

Sophomore Year

Fall Term 3
- Elective - 3/4

Spring Term 4
- Elective - 3/4

Junior Year

Fall Term 5
- Elective - 3/4

Spring Term 6
- Elective - 3/4

Senior Year

Fall Term 7
- Elective - 1/4

Spring Term 8
- Elective - 1/4

These requirements are effective for students admitted to the Electrical Engineering major beginning Fall 2017.
Environmental Engineering
Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

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: BS161 Cell and Molecular Biology  3

d. Technical Electives. Complete at least three courses for a minimum of 9 credits of electives from the list below or by approval of the department. Students may substitute a 3-credit experiential education experience for one of the three courses. The experience is obtained in a minimum of three out-of-classroom experiences through engineering cooperative education. Students must contact the department for approval.

ANS 427  Environmental Toxicology and Society  3
BE 469  Sustainable Bioenergy Systems  3
BE 482  Diffuse-Source Pollution Engineering  3
CSS 455  Environmental Pollutants in Soil and Water  3
CSUS 320  Environmental Planning and Management  3
CSUS 425  Environmental Impact Assessment  3
FW 414  Aquatic Ecosystem Management  3
FW 417  Wetland Ecology and Management  3
FW 420  Stream Ecology  3
FW 443  Restoration Ecology  3
FW 472  Limnology  3
GLG 411  Hydrogeology  3
GLG 412  Glacial Geology & the Record of Climate Change  3
GLG 421  Environmental Geochemistry  4
IBIO 303  Oceanography  4
IBIO 353  Marine Biology (W)  4
IBIO 355  Ecology  3
IBIO 446  Environmental Issues and Public Policy  3
ISS 310  People and Environment (I)  4

Other Electives (Variable)

Total Credits Required for Degree

The requirements listed above apply to students admitted to the Department of Civil & Environmental Engineering (CEE) beginning Fall 2016. The Department of Civil & Environmental Engineering (CEE) 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 Environmental Engineering should contact the Civil & Environmental Engineering Department Advising Office, 3579 Engineering Building, phone (517) 355-3274. For scheduling academic advising appointments visit: https://msu.campus.eab.com

Last revised May 2017

2. College Requirements: (30)
*CEM 141  General Chemistry  4

OR
*CEM 151  General and Description 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: (66-68)
a. Complete all of the following courses: (48)
BS 162  Organismal and Population Biology  3
CE 221  Statics  3
CE 273  Civil & Environmental Engineering Measurements  2
CE 274  Graphics for Civil & Environmental Engineers  1
CE 321  Introduction to Fluid Mechanics  4
CE 371  Sustainable Civil & Environmental Egr Systems  3
CE 372  Risk Analysis in Civil & Environmental Engineering  2
CE 495  Senior Design in Civil & Environmental Engineering  4

CSEM 161  Chemistry Laboratory I  1
CHE 201  Materials and Energy Balances  3
ENE 280  Principles of Environ Engineering and Science  3
ENE 421  Engineering Hydrology  3
ENE 422  Applied Hydraulics  3
ENE 480  Environmental Measurements Laboratory  1
ENE 481  Environmental Chemistry: Equilibrium Concepts  3
ENE 483  Water & Wastewater Engineering  3
ENE 487  Microbiology for Environmental Science & Egr  3
ENE 489  Air Pollution: Science and Engineering  3

b. Complete one of the following courses: (3)
CEM 142  General & Inorganic Chemistry  3
CEM 152  Principles of Chemistry  3

c. Complete one of the following courses: (3-4)
CHE 321  Thermodynamics for Chemical Engineering  4
ME 201  Thermodynamics  3

d. Complete one of the following courses: (3-4)
GLG 201  The Dynamic Earth  4
GLG 301  Geology of Continents and Oceans  3

To other Electives (Variable)

Michigan State University | College of Engineering | Engineering Undergraduate Studies
Engineering Building, 428 S. Shaw Lane, Room 1415, East Lansing MI 48824 | (517) 355-6616
http://www.egr.msu.edu/undergraduate/academic/degree-programs
Environmental Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Environmental Engineering major beginning Fall 2016.

The chart outlines the course requirements for students in different years, with prerequisites and concurrent courses indicated. The legend at the bottom explains symbols like arrows for prerequisite courses, rounded boxes for courses offered only in specific semesters, and diversity categories represented by "N," "I," or "D." The chart is designed to help students understand the sequence and necessary courses for progression through the Environmental Engineering program.
1. **University Requirements:** (23-24)
   - Writing, Rhetoric and American Cultures (WRA) 4
   - Integrative Studies in Humanities (IAH 201-210 & IAH 211 or >) 8
   - Integrative Studies in Social Sciences (ISS 2XX & 3XX) 8
   - Bioscience (one of the following):
     - BS 161, ENT 205, IBIO 150, MMG 141, MMG 201, PLB 105, PSL 250 3-4

2. **College Requirements:** (30)
   - *CEM 151 General and Descriptive Chemistry* 4
   - *CEM 100 Introduction to Engineering Design* 2
   - *CEM 120 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:** (62)
   a. Complete all of the following: (41)
      - CE 221 Statics 3
      - CE 152 Principles of Chemistry 3
      - CE 161 Chemistry Laboratory I 1
      - ***ECE 345 Electronic Instrumentation & Systems* 3
      - ME 222 Mechanics of Deformable Solids 3
      - MSE 250 Materials Science and Engineering 3
      - MSE 260 Electronic, Magnetic, Thermal & Optical Properties of Materials 3
      - MSE 310 Phase Equilibria in Materials 3
      - MSE 320 Mechanical Properties of Materials 3
      - MSE 331 Materials Characterization Methods I 2
      - MSE 360 Fundamentals of Microstructural Design 3
      - MSE 370 Synthesis & Processing of Materials 3
      - MSE 381 Materials Characterization Methods II 2
      - MSE 466 Design and Failure Analysis (W) 3
      - STT 351 Probability & Statistics for Engineering 3
    
    b. Select four of the following courses: (12)
      - MSE 425 Biomaterial & Biocompatibility 3
      - MSE 460 Electronic Struct, Bonding in Materials & Devices 3
      - MSE 465 Design & Application of Engr Materials 3
      - MSE 474 Ceramic and Refractory Materials 3
      - MSE 476 Phys Mturgy of Ferrous & Alumn Alloys 3
      - **MSE 477 Manufacturing Processes** 3
    
    c. Complete at least 6 credits from 400-level courses within the College of Engineering: (6)
    
    d. **Technical Electives:** (3)
      Complete at least 3 credits in courses selected from a list of approved technical electives available from the Department of Chemical Engineering and Materials Science.

**Concentrations**

Students may elect to complete a more focused set of courses to enhance their ability to function at the interface with another scientific, engineering, or business discipline. Concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree in Materials Science and Engineering. Completing the Bachelor of Science degree in Materials Science and Engineering with a concentration may require more than 128 credits. The concentration will be noted on the student's transcript.

**Biomedical Materials Engineering Concentration:** (28)

To gain interdisciplinary skills in human biology and earn a Bachelor of Science degree in Materials Science and Engineering with a biomedical materials engineering concentration, students must complete requirement 3. a. above and the following:

1. Complete all of the following: (16)
   - ANTR 350 Human Gross Anatomy for Pre Health Prof 3
   - CEM 351 Organic Chemistry I 3
   - IBIO 341 Fundamental Genetics 4
   - ME 495 Tissue Mechanics 3
   - MSE 425 Biomaterials and Biocompatibility 3

2. Complete two of the following courses: (6)
   - MSE 460 Electronic Struct, Bonding in Materials & Devices 3
   - MSE 465 Design and Application of Egr. Materials 3
   - MSE 474 Ceramics and Refractory Materials 3
   - MSE 476 Phys Metallurgy of Ferrous & Alumn Alloys 3
   - **MSE 477 Manufacturing Processes** 3

3. **Technical Electives:** (6)
   An approved list of Technical Electives is available from the adviser.

**Manufacturing Engineering Concentration:** (21)

To gain interdisciplinary skills with business and design engineers for manufacturing projects and earn a Bachelor of Science degree in Materials Science and Engineering with a manufacturing engineering concentration, students must complete requirement 3. a. above and the following:

1. Complete all of the following: (12)
   - ECE 415 Computer Aided Manufacturing 3
   - **MSE 477 Manufacturing Processes** 3
   - ME 478 Product Development 3
   - MSE 465 Design and Application of Egr. Materials 3

2. Complete three of the following courses: (9)
   - GBL 323 Introduction to Business Law 3
   - **MSE 426 Introduction to Composite Materials** 3
   - MSE 474 Ceramic and Refractory Materials 3
   - MSE 476 Phys Metallurgy of Ferrous and Alumn Alloys 3
Metallurgical Engineering Concentration: (21)
To enhance the student’s ability to characterize, process, and design with metals in association with mechanical engineers and earn a Bachelor of Science degree in Materials Science and Engineering with a metallurgical engineering concentration, students must complete requirement 3.a. above and the following:

1. Complete all of the following: (18)
   - ME 423 Intermediate Mechanics of Deformable Solids 3
   - ME 475 Computer Aided Design of Structures 3
   - **MSE 477 Manufacturing Processes 3
   - MSE 465 Design and Application of Egr. Materials 3
   - MSE 476 Phys Metallurgy of Ferrous & Alum Alloys 3
   - MSE 481 Spectroscopic & Diffraction Analysis of Materials 3

2. Complete one of the following courses: (3)
   - ME 425 Experimental Mechanics 3
   - **MSE 426 Introduction to Composite Materials 3

Polymeric Engineering Concentration: (21)
To gain interdisciplinary skills to facilitate interactions with chemical engineers and earn a Bachelor of Science degree in Materials Science and Engineering with a polymeric engineering concentration, students must complete requirement 3. a. above and the following:

Complete all of the following: (18)
   - CEM 351 Organic Chemistry I 3
   - CHE 311 Fluid Flow and Heat Transfer 3
   - CHE 472 Composite Materials Processing 3
   - CHE 473 Chem Engr Prncips in Polymrs & Matls Sys 3
   - **MSE 426 Introduction to Composite Materials 3
   - MSE 460 Electronic Structure & Bonding in Materials & Devices 3
   - Any approved 890-891 independent study or topics course 3

Complete the following: (3)
At least 3 credits in courses from a list of approved technical electives available from the Department of Chemical Engineering and Materials Science.

The requirements listed apply to students admitted to the major of Materials Science and Engineering in the Department of Chemical Engineering and Materials Science (CHEMS) beginning Spring 2016. 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 Materials Science and Engineering should contact Chemical Engineering and Materials Science Department Advising Office, 3512 Engineering Building, phone 517-432-4916. For scheduling academic appointments visit: https://msu.campus.eab.com

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.

* College Admission Requirement
**To enroll MSE 426 & MSE 477, enroll in ME 426 & ME477
***ECE 302 and ECE 303 may be substituted for ECE 345

Total Credits Required for Degree 128

Last Revised May 2017

NOTES:
Materials Science and Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Materials Science and Engineering major beginning Spring 2016.
Mechanical Engineering
Accredited by the Engineering Accreditation Commission of ABET, www.abet.org

1. University Requirements: (23-24)
   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 (one of the following):
      BS 161, ENT 205, IBIO 150, MMG 141,
      MMG 201, PLB 105, PSL 250 3-4

2. College Requirements: (32)
   *CEM 141 General Chemistry 4
   *CSE 231 Introduction to Programming I 4
   *EGR 100 Introduction to Engineering Design 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 Requirements

3. Major Requirements: (65)
   a. Complete all of the following courses: (13)
      CE 221 Statics 3
      CEM 161 Chemistry Laboratory I 1
      ECE 345 Electronic Instrumentation and Systems 3
      MSE 250 Materials Science and Engineering 3
      STT 351 Probability and Statistics for Engineering 3
   b. Complete all of the following courses: (40)
      ME 201 Thermodynamics 3
      ME 222 Mechanics of Deformable Solids 3
      ME 280 Graphic Communications 2
      ME 300 Professional Issues in Mechanical Eng 1
      ME 332 Fluid Mechanics (W) 4
      ME 361 Dynamics 3
      ME 371 Mechanical Design I 3
      ME 391 Mechanical Engineering Analysis 3
      ME 410 Heat Transfer 3
      ME 412 Heat Transfer Laboratory (W) 2
      ME 451 Control Systems (W) 4
      ME 461 Mechanical Vibrations 3
      ME 471 Mechanical Design II 3
      ME 481 Mechanical Engr Design Projects (W) 3
   c. Senior Electives: (9)
      Complete a minimum of nine credits from the following:
      ME 416 Computer Asstd Design of Thermal Sys 3
      ME 417 Design of Alternative Energy Systems 3
      ME 422 Introduction to Combustion 3
      ME 423 Intermed Mech of Deformable Solids 3
      ME 425 Experimental Mechanics 3
      ME 426 Introduction to Composite Materials 3
      ME 433 Intro to Computational Fluid Dynamics 3
      ME 440 Aerospace Engineering Fundamentals 3
      ME 442 Turbomachinery 3
      ME 444 Automotive Engines 3
      ME 445 Automotive Powertrain Design 3
      ME 456 Mechatronic System Design 3
      ME 464 Intermediate Dynamics 3
      ME 465 Computer Aided Optimal Design 3
      ME 475 Computer Aided Design of Structures 3
      ME 477 Manufacturing Processes 3
      ME 478 Product Development 3
      ME 490 Independent Study in Mechanical Engr 1-4
      ME 491 Selected Topics in Mechanical Engr 1-4
      ME 494 Biofluid Mechanics and Heat Transfer 3
      ME 495 Tissue Mechanics 3
      ME 497 Biomechanical Design in Product Dev 3
   d. Design-Intensive courses. Complete a minimum of three additional credits from: (3)
      ME 416 Computer Ast Design of Thermal Sys 3
      ME 417 Design of Alternative Energy Systems 3
      ME 442 Turbomachinery 3
      ME 445 Automotive Powertrain Design 3
      ME 456 Mechatronic System Design 3
      ME 465 Computer Aided Optimal Design 3
      ME 475 Computer Aided Design of Structures 3
      ME 497 Biomechanical Design in Product Dev 3
      Courses used to fulfill item 3.c. may not be used to fulfill 3.d.
Concentrations:
The Department offers concentrations in automotive powertrain, biomedical engineering, computational design, energy, engineering mechanics, global engineering, and manufacturing engineering to students wishing an area of specialization in their degree. The concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree program in mechanical engineering. NOTE: Completing the Bachelor of Science degree in mechanical engineering with a concentration may require more than 128 credits. Upon completion of the required courses for one of these concentrations, certification will appear on the student’s official transcript.

Automotive Powertrain Concentration: (12)
To earn a Bachelor of Science degree in Mechanical Engineering with an automotive powertrain concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. above and the following:

All of the following: (9)
ME 422  Intro to Combustion  3
ME 444  Automotive Engines  3
ME 445  Automotive Powertrain Design  3

One of the following: (3)
ME 433  Intro to Computational Fluid Dynamic  3
ME 442  Turbomachinery  3

Biomedical Engineering Concentration: (16)
To earn a Bachelor of Science degree in Mechanical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. above and the following:

Both of the following courses: (7)
BS 161  Cells and Molecular Biology  3
PSL 250  Introductory Physiology  4

Select nine credits from the following courses: (9)
BE 444  Biosensors for Medical Diagnostics  3
ECE 445  Biomedical Instrumentation  3
ME 494  Biofluid Mechanics and Heat Transfer  3
ME 495  Tissue Mechanics  3
ME 497  Biomechanical Design in Product Dev  3
MSE 425  Biomaterials and Biocompatibility  3

Computational Design Concentration: (12)
To earn an Bachelor of Science degree in Mechanical Engineering with a computational design concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. and the following:

All of the following: (12)
ME 416  Computer Assisted Design of Thermal Systems  3
ME 433  Intro to Computational Fluid Dynamics  3
ME 465  Computer Aided Optimal Design  3
ME 475  Computer Aided Design of Structures  3

Energy Concentration: (12)
To earn a Bachelor of Science degree in Mechanical Engineering with an energy concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. and the following:

All of the following courses: (9)
ME 416  Computer Assisted Design of Thermal Systems  3
ME 417  Design of Alternative Energy Systems  3
ME 422  Intro to Combustion  3

One of the following courses: (3)
ME 440  Aerospace Engineering Fundamentals  3
ME 442  Turbomachinery  3
ME 444  Automotive Engines  3

Engineering Mechanics Concentration: (12)
To earn a Bachelor of Science degree in Mechanical Engineering with an engineering mechanics concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. above and the following:

All of the following: (12)
ME 423  Intermed Mechanics of Deform Solids  3
ME 425  Experimental Mechanics  3
ME 464  Intermediate Dynamics  3
ME 475  Computer Aided Design of Structures  3

Global Engineering: (12)
To earn a Bachelor of Science degree in Mechanical Engineering with a global engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., above and 12 credits of approved mechanical engineering courses from a MSU co-sponsored Study Abroad institution. At least 3 credits must include a team design project.
### Manufacturing Engineering Concentration: (13)
To earn a Bachelor of Science degree in Mechanical Engineering with a manufacturing engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., and 3.d. above and the following:

<table>
<thead>
<tr>
<th>All of the following courses: (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC 210   Economics Principles Using Calculus</td>
</tr>
<tr>
<td>ME 372   Machine Tool Laboratory</td>
</tr>
<tr>
<td>ME 477   Manufacturing Processes</td>
</tr>
<tr>
<td>ME 478   Product Development</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Select one of the following courses: (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 472   Composite Materials Processing</td>
</tr>
<tr>
<td>ECE 415   Computer Aided Manufacturing</td>
</tr>
<tr>
<td>ME 426   Introduction to Composite Materials</td>
</tr>
</tbody>
</table>

### Other Electives (Variable)

### Total Credits Required for Degree 128

The requirements listed apply to students admitted to the major of Mechanical Engineering in the Department of Mechanical Engineering beginning Fall 2016. The Department of Mechanical Engineering (ME) 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 Mechanical Engineering should contact the Mechanical Engineering Department Advising Office, 2560 Engineering Building, phone (517) 355-3338.

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.

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**NOTES:**

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Last Revised August 2016
Mechanical Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Mechanical Engineering major beginning Fall 2016.

**FRESHMAN YEAR**
- **FALL Term 1**: Bioscience – 3/4 (Choose 1 from approved list), CEM 141 – 4 (Gen Cem)
- **SPRING Term 2**: EGR 100 – 2 (Intro Engr Design), MTH 132 – 3 (Calc I)

**SOPHOMORE YEAR**
- **FALL Term 3**: CSE 231-4 (Intro to Programming), MTH 133 – 4 (Calc II)
- **SPRING Term 4**: ME 201 – 3 (Statics), MTH 234 – 4 (Multivar Calc)

**JUNIOR YEAR**
- **FALL Term 5**: ME 280 – 2 (Graphic Comm), MSE 250 – 3 (Matls Sci & Engr)
- **SPRING Term 6**: ME 222 – 3 (Mech of Defrm Sol), ME 300 – 1 (Prof Issues in ME (P: WRA 1XX))
- **FALL Term 7**: ME 201 – 3 (Thermodynamics), ME 361 – 3 (Dynamics)
- **SPRING Term 8**: ME 221 – 3 (Mech Engr Analy), ME 391 – 3 (Mechanical Des I)

**SENIOR YEAR**
- **FALL Term 9**: ME 312 – 2 (Heat Transfer Lab (Preq: WRA 100)), ME 362 – 3 (Mechanical Des II)
- **SPRING Term 10**: ME 441 – 3 (Heat Transfer), ME 481 – 3 (ME Design Projects (P: WRA 100))

**Senior Elective**: 3 (From approved list)

**Legend**
- Prerequisite
- Prerequisite or Concurrent
- "Div": Complete courses in at least 2 out of 3 diversity categories - "N", "I" or "D"

Last Revised: 08/19/16