College of Engineering
Undergraduate
Student Handbook
2015-2016
Oh, the things you will do!

**Cornerstone Design**  
**National Competitions**  
**Internships**  
**Undergraduate Research**  
**Capstone Design**  
**Co-op employment**  
**Study Abroad**  
**Student Organizations**  
**Residential Experience**  
**ACADEMICS**

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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<thead>
<tr>
<th>Office/Department</th>
<th>Location</th>
<th>Phone #</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Advising</td>
<td>1415 Engineering</td>
<td>355-6616 ext. 1</td>
<td><a href="http://www.egr.msu.edu/undergraduate/academic/advisors">http://www.egr.msu.edu/undergraduate/academic/advisors</a></td>
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<tr>
<td>Academic Advising First Year</td>
<td>W-8 Wilson Hall</td>
<td>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>
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<td>Engineering Students</td>
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<tr>
<td>Admissions</td>
<td>250 Admin Bldg.</td>
<td>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>C 101 Wilson Hall</td>
<td>1-877-9LIVE0N</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>355-9715</td>
<td><a href="http://www.chemistry.msu.edu">www.chemistry.msu.edu</a></td>
</tr>
<tr>
<td>CoRe</td>
<td>W-8 Wilson Hall</td>
<td>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>355-8270</td>
<td><a href="http://www.counseling.msu.edu">www.counseling.msu.edu</a></td>
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<tr>
<td>Diversity Programs Office (DPO)</td>
<td>1108 Engineering</td>
<td>355-8310</td>
<td><a href="http://www.egr.msu.edu/dpo">www.egr.msu.edu/dpo</a></td>
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<tr>
<td>English Language Center (ELC)</td>
<td>B-204 Wells Hall</td>
<td>353-0800</td>
<td><a href="http://www.elc.msu.edu">www.elc.msu.edu</a></td>
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<tr>
<td>Financial Aid</td>
<td>252 Student Services</td>
<td>353-5940</td>
<td><a href="http://www.finaid.msu.edu">www.finaid.msu.edu</a></td>
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<tr>
<td>IAH Department</td>
<td>200 Linton Hall</td>
<td>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>355-9733</td>
<td><a href="http://www.cis-ss.msu.edu">www.cis-ss.msu.edu</a></td>
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<tr>
<td>Math Department</td>
<td>C212 Wells Hall</td>
<td>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>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>353-1720</td>
<td><a href="http://www.isp.msu.edu/OISS">www.isp.msu.edu/OISS</a></td>
</tr>
<tr>
<td>Physics Department</td>
<td>1312 BPS Building</td>
<td>355-9200 x3</td>
<td><a href="http://www.pa.msu.edu">www.pa.msu.edu</a></td>
</tr>
<tr>
<td>Department of Police &amp; Public Safety (DPPS)</td>
<td>1120 Red Cedar Rd.</td>
<td>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>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>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 Engineering</td>
<td>355-5163</td>
<td><a href="http://www.egr.msu.edu/thecenter">www.egr.msu.edu/thecenter</a></td>
</tr>
<tr>
<td>Undergraduate University Division (UUD)</td>
<td>170 Bessey Hall</td>
<td>355-3515</td>
<td><a href="http://www.msu.edu/dept/uud">www.msu.edu/dept/uud</a></td>
</tr>
<tr>
<td>Women in Engineering (WIE) Program</td>
<td>1108 Engineering Bldg.</td>
<td>355-6616 ext. 3</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>432-3610</td>
<td><a href="http://www.writing.msu.edu">www.writing.msu.edu</a></td>
</tr>
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</table>
2015- 2016 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 2015

August 29  New Freshmen and Transfer students attending an AUGUST orientation can move into residence halls beginning at 8 am
August 30  New Freshmen and Transfer students who attended JUNE or JULY orientation can move into residence halls beginning at 8 am
September 2  Classes begin, Monday schedule is observed
September 7  Labor Day- University closed
September 9  **End of open add period; 8PM**
September 28  **End of tuition refund period**
October 21  Middle of Semester, LAST day to drop classes with no grade reported; 8PM
November 26-27  Thanksgiving holiday- University closed
December 11  End of classes for Fall Semester
December 11  Engineering Design Day
December 14-18  Final exams

Spring 2016

January 11  Classes begin
**January 15**  **End of open add period; 8PM**
January 18  Martin Luther King, Jr. Day, no classes, university remains open
February 5  **End of tuition refund period**
March 2  Middle of Semester, LAST day to drop classes with no grade reported; 8PM
March 7-11  Spring break
April 29  Classes end
April 29  Engineering Design Day
May 2-6  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. Academic advisors are here to guide you along the way and provide you with valuable information to help you make good academic decisions.

How do I know who my advisor is?
Are you a first year student? If so, you will find your advisor in Wilson Hall, Room W-8. All advising is done on a drop-in basis, and no appointments are necessary. Wilson advising is open Monday-Thursday, 10am-5pm and Fridays from 10am-2pm. Questions? Call (517) 355-6616 x2

Are you a sophomore/junior/senior? Students at these levels are assigned to an advisor by major:

Applied Engineering Sciences
- Dr. Amanda Idema, 1415 Engineering Building, (517) 355-6616 x1, call for appointment

Biosystems Engineering, Civil Engineering, Environmental Engineering
- Dan King, 3579 Engineering Building, (517) 355-3274, schedule online at https://www.egr.msu.edu/adcalendar/

Chemical Engineering, Materials Science Engineering
- Joyce Samuel, 3508 Engineering Building, (517) 432-1352, schedule online at https://www.egr.msu.edu/adcalendar/

Computer Engineering, Electrical Engineering
- Sean Fochtman, 2212 Engineering Building, (517) 355-5242, schedule online at https://www.egr.msu.edu/adcalendar/

Computer Science
- Amber Benton, 3201 Engineering Building, (517) 355-5455, schedule online at https://www.egr.msu.edu/adcalendar/

Mechanical Engineering
- Sophomores – seen in Wilson Hall, room W-8, (517) 355-6616 x2
- Juniors and Seniors, Gaile Griffore, 2560 Engineering Building, (517) 355-3338, call for an appointment

If you have questions about finding your advisor, stop by W-8 Wilson Hall, 1415 Engineering Building, or call (517) 355-6616 ext. 1. More information is also available at:
How often should I meet with my advisor?
We suggest that you meet with your advisor regularly, 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.

How should I prepare for my advising appointment?
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) and schedule of courses (http://schedule.msu.edu/).
- Bring a preliminary schedule of courses you intend to take.
- Think about any questions you might have about your major, the College of Engineering, or the University. Make sure to write them down and bring them to your appointment.

Academic Programs catalog
Academic Programs is the listing of academic programs, degree requirements, policies and related information. Course Descriptions is the course listing. Together, they comprise the Michigan State University catalog. Updates to Academic Programs occur throughout the year, with the most updated information available online.

Students should consult with their advisors to learn which specific requirements apply to their degree programs. The academic programs catalog can be viewed online at: 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.

The most updated version can be found online at http://splife.studentlife.msu.edu.
Admission to the College of Engineering

Students are admitted to the College of Engineering as soon as they have completed the required core courses and have met specific GPA requirements for their intended major. 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
- attained a minimum of 2.00 grade-point average in all mathematics courses (other than MTH1825) taken at MSU.

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

- 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
  - (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.)
- CEM 141- General Chemistry or CEM 151 General and Descriptive Chemistry for all majors except Computer Science
- 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 and Computer Science majors only)
  OR CSE 220- Programming in C, (for Electrical Engineering majors only.)

As of August, 2015, 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

*These admission GPAs are subject to review. Please see an advisor for the most up to date information.*
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>
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<tr>
<td>Total</td>
<td>15</td>
<td></td>
<td></td>
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<td>44.5</td>
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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](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>
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<td>=</td>
<td>7.5</td>
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<tr>
<td>CEM 141</td>
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<td>x</td>
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<tr>
<td>CEM 161</td>
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<tr>
<td>Total</td>
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<td></td>
<td>32.5</td>
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</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.

Advisors will help you balance these four areas, as well as any additional minors/concentrations you wish to explore. These four areas are explained in more detail in the next several pages.

1. University Requirements

Writing, Rhetoric, and American Cultures (WRA)

- All MSU students must complete two WRA courses, **one at the Tier I level** and **one at the Tier II level**. Tier I classes are numbered 110-150 and are generally taken during the first year. Tier II classes are always completed through a student’s major, usually in the junior or senior year.
- Students needing additional help in writing (as determined by ACT/SAT scores) will be required to enroll in WRA 1004: Preparation for College Writing and WRA 0102: Preparation for College Writing (lab) before completing the Tier I WRA course.
- Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program (CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

Integrative Studies in Social Sciences (ISS)

- All MSU students must complete two ISS courses, **one 200-level** course followed by one **300-level** course. These courses can be completed at any time during the undergraduate program.
- Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program (CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

Integrative Studies in Arts and Humanities (IAH)

- All MSU students must complete two IAH courses. **Choice A is numbered 201-210** course followed by **Choice B, numbered 211 or higher**. These courses can be completed at any time during the undergraduate program.
- Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program
(CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

**Integrative Studies Diversity Requirement**
- IAH and ISS courses are designated as having an emphasis in national diversity (N), international and multicultural diversity (I) or national, international and multicultural diversity (D). As you complete your 4 IAH/ISS courses, you must have at least one “N” and one “I” course. A “D” course designation may meet either an “N” or an “I” requirement, but not both. Students may have any combination of the three designations, but not two of the same. For example, two “D” designations will not fulfill the university diversity requirement.
- For the most current information, students should check the course descriptions website at: [http://www.reg.msu.edu/Courses/Search.asp](http://www.reg.msu.edu/Courses/Search.asp)

**Bioscience**
- Engineering students do not take ISB or ISP (science courses for non-science majors). Instead, MOST majors allow for any of the following: BS161, ENT205, MMG201, PLB105, PSL250, ZOL141
- Environmental Engineering (ENE) and Chemical Engineering (ChE) majors must take BS 161 to satisfy both the University requirement and their major bioscience requirement.
- Biosystems Engineering (BE) majors must take BS 161 to satisfy a major requirement and must also take BS 162 to satisfy the University requirement. It is important to keep in mind that BS 161 is a prerequisite for BS 162.
- The Computer Science (CpS) major also has stipulations regarding the bioscience requirement. Please refer to the Computer Science curriculum guide for this information.
- Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program (CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

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, Materials Science, and Mechanical Engineering.

- **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 or Computer 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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 132</td>
<td>Calculus I*</td>
</tr>
<tr>
<td>MTH 133</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MTH 234</td>
<td>Multivariable Calculus</td>
</tr>
<tr>
<td>MTH 235</td>
<td>Differential Equations (not required for AES or CPS)</td>
</tr>
</tbody>
</table>

*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 MTH103 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 MTH116 or higher)
- Required for: Chemical Engineering, Environmental Engineering, and Materials Science and Engineering

Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program (CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

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

Strong scores on tests such as Advanced Placement (AP), International Baccalaureate (IB) Diploma Program, College-Level Examination Program (CLEP), Dantes Subject Standardized Tests (DSST), and International A Level may allow for a course waiver or course credit, as well as some dual enrollment credit from high school. Check with an advisor for details.

**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.

PHY231 + PHY233B = PHY183  
PHY232 + PHY234B = PHY184
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 online. 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. These are courses at MSU that you are eligible to take, and allow you to broaden your academic horizons by exploring other subjects. You can “spend” your elective credits any way you wish, but know that they are a part of your degree.

What are some electives you might like to take?

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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 bioimaging 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.

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?
Undergraduate programs in environmental and ecosystems engineering are distributed across the Environmental Engineering, Biosystems Engineering (Ecosystems Engineering Concentration), and Chemical Engineering (Environmental Engineering Concentration) majors.
**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 chemical-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 [www.reg.msu.edu](http://www.reg.msu.edu) for an up to date list. The College of Engineering offers 2 minors:

**Minor in Computer Science**
The academic minor in Computer Science will provide a basic 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.

**Requirements**
Complete 18 credits in Computer Science and Engineering as follows:

- CSE 231 (4 credits) Introduction to Programming I
- CSE 232 (4 credits) Introduction to Programming II
- CSE 260 (4 credits) Discrete Structures
- Two courses from CSE 320, 331, 335, 410, 420, 422, 425, 435, 440, 450, 460, 471, 472, 473, 476, 477, 480, or 484
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.

Requirements
Complete 18 credits from the following

- MSE 250 (3 credits) Materials Science and Engineering
- MSE 360 (3 credits) Fundamentals of Microstructural Design*
- One course from MSE 260, 310, 320, 370
- Three courses from MSE 310, 320, 370, 410, 425, 451, 454, 460, 465, 466, 476, or 477

A course used to fulfill requirement 2 above may not be used to fulfill requirement 3.

* This course has a prerequisite of MSE 310, a course covering thermodynamics. For the minor, ME 201, CHE 321, or PHY 215 is also acceptable, but students will need to do some background study of regular solutions and phase diagrams that are covered in the latter half of MSE 310.

Notes
**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

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### MTH 1825 placement, second year

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## Notes

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Academic Resources

Academic Assistance
As a first-year student, you are beginning the transition from high school to the rigors of the college curriculum. As a college student, you will be trained and challenged to think in new and exciting ways. 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, Wells Hall and Neighborhood Engagement Centers
• Writing Center, 300 Bessey Hall

Time Management
The key to academic success in college is to develop good time management skills early in the semester and to designate time to your studies every day. It is okay to ask for help. See your advisor for more information. We are here to help you succeed!

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.

If you are ready to start exploring experiential education opportunities, or just want to see what positions might be available, sign up on MySpartanCareer.com to access Experiential Education’s online application and job postings. Depending on the opportunity, you can begin working your freshman year.

For more information, please visit our website: www.egr.msu.edu/careers, stop by 1340 Engineering Building, or call us at (517) 355-5163.

The Center Staff-
Garth Motschenbacher, Director of Employer Relations
Bernadette Friedrich, Ph.D., Director of Student Advancement
Kyle Liechty, Co-op / Intern Coordinator
Rachel Mangiavellano, Career Consultant
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, Student Services Assistant
Bryndan Arnold, Guided Learning Center Coordinator
Robin Smith, Secretary

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.

*The CoRe Staff-*
S. Patrick Walton, Sc.D., Director
Carmellia Davis-King, Co-Curricular Director
Timothy Hinds, CoRe Academic Director
Sandra Christlieb, Project Engineer
Jeanette Robertson, Secretary
Engineering Study 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 University Study 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) 355-8310.

The Study Abroad Staff-
Maggie Blair-Ramsey, Study Abroad Coordinator

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/scholarships

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, stop by the office in 1340 Engineering Building, or call at (517) 355-6616, ext.3.

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, with many geared towards international student interests. For information on international-specific student groups, please visit: http://oiss.isp.msu.edu/students_clubs.php. We also encourage international students to become involved and engaged with Engineering student groups.

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 for more information.

Questions? See...

- Your academic advisor
- The Center for Spartan Engineering (experiential education, jobs)
- The Diversity Programs Office
- The Women in Engineering Office
- The Engineering Study Abroad Office
- Spartan Engineering tweets and LinkedIn groups

Notes
What are the engineering disciplines?

Applied Engineering Sciences (AES) ~ http://aes.egr.msu.edu/
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) ~ http://www.egr.msu.edu/age/
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
ENGINEERING DEGREE PROGRAMS AND MAJOR REQUIREMENTS

The information listed here is current as of April 2015. 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)
- Writing, Rhetoric and American Cultures (WRA) 4
- Integrative Studies in Humanities (IAH) 8
- Integrative Studies in Social Sciences (ISS) 8
- Bioscience (one of the following):
  - BS 161, ENT 205, MMG 201 3-4
  - PLB 105, PSL 250, ZOL 141

### 2. College Requirements: (27)
- 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
- PHY 183 Physics for Scientists & Engineers I 4
- PHY 184 Physics for Scientists & Engineers II 4

### 3. Major Requirements: (64-67)
#### A. Complete all of the following courses: (46)
- ACC 230 Survey of Accounting Concepts 3
- CE 221 Statics 3
- CEM 161 Chemistry Laboratory I 1
- COM 225 Intro to Interpersonal Communication 3
- EC 201 Introduction to Microeconomics 3
- EC 202 Introduction to Macroeconomics 3
- ECE 201 Circuits and Systems I 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
- MGT 325 Management Skills and Processes 3
- 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)
- BE 230 Engr Analysis of Biological Systems 3
- ENE 280 Principles of Environ Engr & Science 3

**Total credits Required for Degree** 120

The requirements listed above apply to students admitted to the major of Applied Engineering Sciences in the Engineering Undergraduate Studies Office (UGS) beginning Fall, 2015. 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 advisor 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, 1415 Engineering Building, phone (517) 355-6616 extension 1.

### 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 3
   - GBL 295 Law, Public Policy, and Business 3
   - GBL 480 Environmental Law & Sustainability for Business: From Local to Global 3
   - PHY 192 Physics Laboratory for Scientists, II 1

#### 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 or 4 credits):
   - CSE 302 Computer Organization & Architecture 3
   - CSE 331 Algorithms and Data Structures 3
   - CSE 335 Object-oriented Software Design 4

#### Packaging (18)
- 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

#### Supply Chain Management: (15)
- EGR 102 Introduction to Financial Management 3
- MKT 327 Introduction to Marketing 3
- SCM 308 Introduction to Supply Chain Management 3
- SCM 371 Procurement & Supply Management 3
- SCM 372 Manufacturing Planning and Control 3
<table>
<thead>
<tr>
<th>Technical Sales: (18)</th>
<th>Media and Information: (18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM 360  Advanced Sales Communication  3</td>
<td>MI 101 Understanding Media in the Information Age 3</td>
</tr>
<tr>
<td>COM 483  Practicum in Sales Communication 1</td>
<td>MI 201 Introduction to Media &amp; Information Technology &amp; Industries 3</td>
</tr>
<tr>
<td>FI 320  Introduction to Finance 3</td>
<td>MI 300 Media Policy and Economics 3</td>
</tr>
<tr>
<td>MKT 313  Personal Selling and Buying Processes 3</td>
<td>MI 301 Bringing Media to Market 3</td>
</tr>
<tr>
<td>MKT 327  Introduction to Marketing 3</td>
<td>MI 361 Information &amp; Communication Tech Mgt 3</td>
</tr>
<tr>
<td>MKT 383  Sales Management 3</td>
<td>MI 458 Project Management (W) 3</td>
</tr>
<tr>
<td>SCM 474  Negotiations 2</td>
<td></td>
</tr>
</tbody>
</table>

Other Electives (Variable)
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) 8
- Integrative Studies in Social Sciences (ISS) 8
- Bioscience: BS 161 Cell and Molecular Biology 3

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

3. Major Requirements: (63-65)
a. Complete all of the following courses: (43)
- 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 EGR 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 321 Introduction to Fluid Mechanics 4
- CEM 143 Survey of Organic Chemistry 4
- CEM 161 Chemistry Laboratory I 1

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)
- MMG 301 Introductory Microbiology 3
- PLB 301 Introductory Plant Physiology 3
- PSL 250 Introductory Physiology 4
- ZOL 341 Fundamental Genetics 4
- ZOL 355 Ecology 3

d. Select one of the following courses: (3-4)
- BLD 450 Eukaryotic Pathogens 3
- CSS 442 Agricultural Ecology 3
- FOR 404 Forest Ecology 3
- FSC 440 Food Microbiology 3
- MMG 425 Microbial Ecology 3
- MMG 445 Microbial Biotechnology (W) 3
- PLB 402 Biology of Fungi 3
- PLB 424 Algal Biology 4
- PSL 425 Physiological Biophysics 3

3. One of the following courses: (3-4):
- CHE 417 Biochemical Engineering 3
- CHE 882 Advanced Biochemical Engineering 3
- CHE 883 Multidisciplinary Bioprocessing Laboratory 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 3
- PLB 424 Algal Biology 4

Courses used to fulfill requirement 2. in this concentration may not be used to fulfill requirement 3.
Biomedical Engineering Concentration

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. The following course: (3)
   BE 444  Biosensors for Medical Diagnostics  3

2. One of the following courses: (3)
   ECE 445  Biomedical Instrumentation  3
   ME 494  Biofluid Mechanics and Heat Transfer  3

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

4. Two of the following: (5-6)
   BLD 204  Mechanisms of Disease  3
   BLD 430  Molecular Laboratory Diagnostics  2
   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 requirements 2. and 3. in this concentration may not be used to fulfill requirement 4.

Ecosystems Engineering Concentration

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

Other Electives (Variable)

Total Credits Required for Degree  128

Food Engineering Concentration

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:

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

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 2011. 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) 355-3274. For scheduling academic advising appointments visit: https://www.egr.msu.edu/adcalendar/

Last revised May 2015
Biosystems Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Biosystems Engineering major beginning Fall 2011.

Michigan State University | College of Engineering | Engineering Undergraduate Studies
Engineering Building, 428 S. Shaw Lane, Room 1415, East Lansing MI 48824 | (517) 355-6616 ext. 1
http://www.egr.msu.edu/undergraduate/academics/programs

Legend:
- Prerequisite
- Prerequisite or Concurrent
- Corequisite

Rounded box: Offered only in the semester listed (excluding summer)
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
   Integrative Studies in Social Sciences (ISS) 8
   Bioscience: BS 161 Cell and Molecular Biology 3

2. College Requirements: (30)
   CEM 151 General and Descriptive Chemistry 4
   EGR 100 Introduction to Engineering Design 2
   EGR 102 Introduction to Engineering Modeling 2
   MTH 132 Calculus I 3
   MTH 133 Calculus II 4
   MTH 234 Multivariable Calculus 4
   MTH 235 Differential Equations 3
   PHY 183 Physics for Scientists & Engineers I 4
   PHY 184 Physics for Scientists & Engineers II 4

3. Major Requirements: (67-69)
   A. Complete all of the following courses: (51)
      CEM 152 Principles of Chemistry 3
      CEM 161 Chemistry Laboratory I 1
      CEM 162 Chemistry Laboratory II 1
      CEM 351 Organic Chemistry I 3
      CEM 352 Organic Chemistry II 3
      CEM 355 Organic Laboratory I 2
      CHE 201 Material and Energy Balances 3
      CHE 210 Modeling and Analysis of Transport Phenomena 3
      CHE 301 Chemical Engineering as a Profession 1
      CHE 311 Fluid Flow and Heat Transfer 3
      CHE 312 Mass Transfer and Separations 4
      CHE 316 Lab Practice and Statistical Analysis (W) 4
      CHE 321 Thermodynamics for Chemical Engineering 4
      CHE 431 Chemical Reaction Engineering 4
      CHE 432 Process Analysis and Control 3
      CHE 433 Process Design and Optimization I 4
      CHE 434 Process Design and Optimization II 2
      CHE 473 Chemical Engr Princ in Polymers & Mats Sys 3

   B. One of the following groups: (4-6)
      **Group 1**
      BMB 401 Basic Biochemistry 4

      **Group 2**
      BMB 461 Biochemistry I 3
      BMB 462 Biochemistry II 3

   C. Select one of the following courses: (3)
      CHE 472 Composite Materials Processing 3
      CHE 481 Biochemical Engineering 3

   D. Select one of the following courses: (3)
      CEM 483 Quantum Chemistry 3
      CEM 484 Molecular Thermodynamics 3

   E. Technical Elective: (6)
      Students must complete at least 6 credits of technically oriented subject-related courses approved by the student's advisor. Acceptable subjects include, but are not limited to, composites processing or biochemical engineering (in addition to that required in 3. c. above), electronic materials, environment, advanced mathematics, transport phenomena, advanced chemistry, foods, legal and regulatory issues, advanced materials, advanced biology, statistics, biomedical engineering, bioenergy, and polymers.

      **Note:** Elective courses in item 3. e. must include at least 3 credits of engineering topics, which includes courses taught in the College of Engineering as well as courses taught in advanced mathematics, advanced chemistry, advanced biology, advanced statistics, and advanced physics. If Biochemistry and Molecular Biology 462 is taken to fulfill requirement 3.b. it will count as technical elective credit in item 3.e.

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

**NOTE:** Completing the Bachelor of Science degree in chemical engineering with a concentration may require more than 128 credits.

Biochemical Engineering Concentration: (11-15)
To earn a Bachelor of Science degree in Chemical Engineering with a biochemical engineering concentration, students must complete requirements 1., 2., 3.a., 3.d., above and the following:

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 481</td>
<td>Biochemical Engineering 3</td>
</tr>
<tr>
<td>MMG 301</td>
<td>Introductory Microbiology 3</td>
</tr>
</tbody>
</table>

**One of the following (4 or 6 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB 401</td>
<td>Comprehensive Biochemistry 4</td>
</tr>
<tr>
<td>BMB 461</td>
<td>Advanced Biochemistry I 3</td>
</tr>
<tr>
<td>BMB 462</td>
<td>Advanced Biochemistry II 3</td>
</tr>
</tbody>
</table>

**Two or three of the following courses. Students who chose BMB 401 in 3.B. must complete three courses. Students who chose BMB 461 and 462 must complete two courses:** (5-9)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB 829</td>
<td>Methods Of Macromolecular Anlys &amp; Synthesis 2</td>
</tr>
<tr>
<td>CHE 882</td>
<td>Advanced Biochemical Engineering 3</td>
</tr>
<tr>
<td>CHE 883</td>
<td>Multidisciplinary Bioprocessing Laboratory 3</td>
</tr>
<tr>
<td>MMG 409</td>
<td>Eukaryotic Cell Biology 3</td>
</tr>
<tr>
<td>MMG 421</td>
<td>Prokaryotic Cell Physiology 3</td>
</tr>
<tr>
<td>MMG 431</td>
<td>Microbial Genetics 3</td>
</tr>
<tr>
<td>MMG 445</td>
<td>Microbial Biotechnology (W) 3</td>
</tr>
</tbody>
</table>
Bioenergy Concentration: (15-16)
To earn a Bachelor of Science degree in Chemical Engineering with a bioenergy engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., 3.d., above and the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 469</td>
<td>Sustainable Bioenergy Systems</td>
<td>3</td>
</tr>
<tr>
<td>CHE 468</td>
<td>Biomass Conversion in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 481</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSS 467</td>
<td>Bioenergy Feedstock Production</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following courses (3-4 credits):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEC 829</td>
<td>Economics of Environ Resources</td>
<td>3</td>
</tr>
<tr>
<td>CHE 882</td>
<td>Advanced Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 883</td>
<td>Multidisciplinary Bioprocessing Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>GLG 471</td>
<td>Applied Geophysics</td>
<td>4</td>
</tr>
<tr>
<td>MC 450</td>
<td>International Environmental Law and Policy</td>
<td>3</td>
</tr>
<tr>
<td>MMG 445</td>
<td>Microbial Biotechnology (W)</td>
<td>3</td>
</tr>
</tbody>
</table>

Biomedical Engineering Concentration: (15-16)
To earn a Bachelor of Science degree in Chemical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., 3.a., 3.b., 3.d., above and the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 481</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MMG 409</td>
<td>Eukaryotic Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>PSL 431</td>
<td>Human Physiology I</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following courses: (6-7)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB 471</td>
<td>Advanced Biochemistry Laboratory (W)</td>
<td>3</td>
</tr>
<tr>
<td>CHE 883</td>
<td>Multidisciplinary Bioprocessing Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>ME 494</td>
<td>Biofluid Mechanics and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ZOL 341</td>
<td>Fundamental Genetics</td>
<td>4</td>
</tr>
</tbody>
</table>

Environmental Concentration: (15)
To earn a Bachelor of Science degree in Chemical Engineering with an environmental concentration, the student must complete requirements 1., 2., and 3. a., 3.b., 3.d., above and the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 481</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENE 280</td>
<td>Principles of Environmental Engr and Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Three of the following courses: (9)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEP 255</td>
<td>Ecological Economics</td>
<td>3</td>
</tr>
<tr>
<td>EEP 320</td>
<td>Environmental Economics</td>
<td>3</td>
</tr>
<tr>
<td>EEP 405</td>
<td>Corporate Environmental Management</td>
<td>3</td>
</tr>
<tr>
<td>ENE 481</td>
<td>Environ Chemistry: Equilibrium Concepts</td>
<td>3</td>
</tr>
<tr>
<td>ENE 483</td>
<td>Water and Wastewater Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENE 489</td>
<td>Air Pollution: Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 485</td>
<td>Landfill Design</td>
<td>3</td>
</tr>
<tr>
<td>CSUS 200</td>
<td>Introduction to Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>CSUS 465</td>
<td>Environmental Law and Policy</td>
<td>3</td>
</tr>
<tr>
<td>ZOL 446</td>
<td>Environmental Issues and Public Policy</td>
<td>3</td>
</tr>
</tbody>
</table>

Food Science Concentration: (12-13)
To earn a Bachelor of Science degree in Chemical Engineering with a food science concentration, students must complete requirements 1., 2., 3. a., 3. b., 3.c., 3.d., above and all of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSC 401</td>
<td>Food Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>FSC 440</td>
<td>Food Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MMG 301</td>
<td>Introductory Microbiology</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following courses: (3-4)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 477</td>
<td>Food Engineering: Fluids</td>
<td>3</td>
</tr>
<tr>
<td>BE 478</td>
<td>Food Engineering: Solids</td>
<td>3</td>
</tr>
<tr>
<td>FSC 325</td>
<td>Food Processing: Unit Operations</td>
<td>3</td>
</tr>
<tr>
<td>FSC 455</td>
<td>Food and Nutrition Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>FSC 470</td>
<td>Integrated Approaches to Food Product Dev</td>
<td>3</td>
</tr>
</tbody>
</table>

Polymer Science and Engineering Concentration: (16-17)
To earn a Bachelor of Science degree in Chemical Engineering with a polymer science and engineering concentration, students must complete requirements 1., 2., 3. a., 3. b., 3. d., above and all of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 221</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>CHE 472</td>
<td>Composite Materials Processing</td>
<td>3</td>
</tr>
<tr>
<td>ME 222</td>
<td>Mechanics of Deformable Solids</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following courses: (6-7)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 871</td>
<td>Materials Surfaces and Interfaces</td>
<td>3</td>
</tr>
<tr>
<td>CHE 872</td>
<td>Polymers &amp; Composites: Mfg, Strc &amp; Prfrmnce</td>
<td>3</td>
</tr>
<tr>
<td>MSE 370</td>
<td>Synthesis and Processing of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 426</td>
<td>Introduction to Composite Materials</td>
<td>3</td>
</tr>
<tr>
<td>PKG 323</td>
<td>Packaging with Plastics</td>
<td>4</td>
</tr>
</tbody>
</table>

Other Electives (Variable)

Total Credits Required for Degree 128

These requirements are effective for students admitted to the Chemical Engineering major beginning Fall 2014. The Department of Chemical Engineering and Materials Science constantly reviews program requirements and reserves the right to make changes as necessary. Consequently, each student is strongly encouraged to consult with his/her adviser to obtain assistance in planning an appropriate schedule of courses. Students who have questions about Chemical Engineering should contact the Chemical Engineering and Materials Science Department Advising Office, 3508 Engineering Building, phone (517) 432-1352. For scheduling academic advising appointments visit: https://www.egr.msu.edu/adcalendar/

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

Last revised May 2015
Chemical Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Chemical Engineering major beginning Fall 2011.

LEGEND

Prerequisite

Prerequisite or Concurrent

"P:" Prerequisite

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

Last Revised: Mar 2012
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) 8
Integrative Studies in Social Sciences (ISS) 8
Bioscience (one of the following): 3-4
BS 161, ENT 205, MMG 201,
PLB 105, PSL 250, ZOL 141

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

3. Major Requirements: (66)
A. Complete all of the following courses: (42)
CE 221 Statics 3
CE 271 Introduction to Civil Engineering & Environmental Engineering 4
CE 272 Civil & Environmental Engineering Analysis 3
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 I 4
CE 341 Transportation Engineering (W) 3
CE 495 Senior Design in Civil & Environmental Engr 4
CEM 161 Chemistry Laboratory I 1
ENE 280 Principles of Environ Engr and Science 3
GLG 301 Geology of the Great Lakes Region 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. Major Tracks: (18)
Complete 18 credits of electives as specified below. At least 9 credits of one track must be completed as specified. The additional 9 credits must include courses from three different tracks. Construction Engineering and Management courses may count towards the additional 9 credits. See the Civil Engineering Academic Adviser for specific track sample programs.

Environmental Track: (9)
1. Complete both of the following courses:
ENE 481 Environ Chem: Equilibrium Concepts 3
ENE 483 Water & Wastewater Engineering 3
2. Complete one of the following courses:
CE 485 Landfill Design 3
ENE 421 Engineering Hydrology 3
ENE 487 Microbiology for Environ Science & Engr 3
ENE 489 Air Pollution: Science & Engineering 3

Geotechnical Track: (9)
1. Complete both of the following courses:
CE 418 Geotechnical Engineering 3
CE 485 Landfill Design 3
2. Complete one of the following courses:
CE 431 Pavement Design and Analysis I 3
CE 815 Selected Topics in Geotechnical Engr 3
CE 818 Advanced Geotechnical Design 3

Pavements Track: (9)
1. Complete both of the following courses:
CE 431 Pavement Design and Analysis I 3
CE 432 Pavement Rehabilitation 3
2. Complete one of the following courses:
CE 418 Geotechnical Engineering 3
CE 831 Advanced Concrete Pavement Anlys & Desn 3
CE 832 Advanced Asphalt Pavement Anlys & Design 3

Structures Track: (9)
1. Complete both of the following courses:
CE 405 Design of Steel Structures 3
CE 406 Design of Concrete Structures 3
2. Complete one of the following courses:
CE 400 Structural Mechanics 3
CE 805 Advanced Design of Steel Structures 3
CE 806 Advanced Structural Concrete Design 3
Transportation Track: (9)
1. Complete both of the following courses:
   - CE 448 Transportation Planning 3
   - CE 449 Highway Design 3
2. Complete one of the following courses:
   - CE 431 Pavement Design and Analysis I 3
   - CE 432 Pavement Rehabilitation 3
   - CE 444 Principles of Traffic Engineering 3

Water Resources Track: (9-10)
1. Both of the following courses:
   - ENE 421 Engineering Hydrology 3
   - ENE 422 Applied Hydraulics 3
2. One of the following courses:
   - ENE 822 Groundwater Modeling 3
   - GLG 411 Hydrogeology 3
   - GLG 412 Glacial Geology & Rcrd of Climate Chng 4

General Track
Students may choose a general track in fulfillment of the Major Track requirement. Students must complete 12 credits from among four different tracks above. Students must also complete 6 additional credits across all tracks which may include course work from Construction Engineering and Management courses below.

Construction Engineering and Management Courses
- CE 471 Construction Engr-Equip, Mthds & Ping 3
- CMP 411 Construction Project Scheduling 3
- CMP 415 Cost Estimating Analysis 3
- CMP 423 Construction Project Management 3

Enrollment in CMP courses requires the approval of the Construction Management Program department.

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 2014. 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 visit: https://www.egr.msu.edu/adcalendar/

Last revised April 2014
Computer 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
   Integrative Studies in Social Sciences (ISS) 8
   Bioscience (one of the following):
     BS 161, ENT 205, MMG 201,
     PLB 105, PSL 250, ZOL 141 3-4

2. College Requirements: (28)
   CEM 141 General Chemistry 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

3. Major Requirements: (69)
   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: (44)
      CSE 231 Introduction to Programming I 4
      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 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 331 Microprocessors & Digital Systems 4
      ECE 390 Ethics, Professions & Cont. Issues 1
      ECE 480 Senior Design (W) 4

   C. Major 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.

      Core Electives: (6)
      At least 6 credits from the following:
      CSE 420 Computer Architecture 3
      ECE 410 VLSI Design (L) 4
      CSE 422* Computer Networks 3
      or
      ECE 442* Introduction to Communication Networks 3
      *(CSE 422 or ECE 442 can count towards you total Core Electives

      Focus Track Electives: (12)
      At least 12 credits from the following:

      Hardware
      ECE 402 Appl 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 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, 2008. 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 April 2014
Computer Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Computer Engineering major beginning Fall 2008.

LEGEND

Prerequisite
Prerequisite or Concurrent

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

* May be interchanged

Last Revised: 07/13/09
Computer Science

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

1. University Requirements: (20)
   Writing, Rhetoric and American Cultures (WRA) 4
   Integrative Studies in Humanities (IAH) 8
   Integrative Studies in Social Sciences (ISS) 8
   Bioscience (See 3A Below)

2. College Requirements (25)
   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
   PHY 183 Physics for Scientists & Engineers I 4
   PHY 184 Physics for Scientists & Engineers II 4

3. Major Requirements (67-69)
   A. Bioscience: (4-6)
      Select one course from Group 1 and one course from Group 2.

   Group 1
   *BS 161 Cell and Molecular Biology 3
   ENT 205 Pests, Society & Environment 3
   MMG 201 Fundamentals of Microbiology 3
   PLB 105 Plant Biology 3
   PSL 250 Introductory Physiology 4
   ZOL 141 Introductory Human Genetics 3

   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: (33)
   CSE 100 Computer Science as a Profession 1
   CSE 231 Introduction to Programming I 4
   CSE 232 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

   C. Select five of the following courses: (15)
      An additional five courses selected from the following (15 credits):
      CSE 420 Computer Architecture 3
      CSE 422 Computer Networks 3
      CSE 425 Introduction to Computer Security 3
      CSE 435 Software Engineering 3
      CSE 440 Introduction to Artificial Intelligence 3
      CSE 450 Translation of Programming Languages 3
      CSE 460 Computability & Formal Language Theory 3
      CSE 471 Media Processing & Multimedia Computing 3
      CSE 472 Computer Graphics 3
      CSE 473 Fundamentals of 3D Game Development 3
      CSE 476 Mobile Application Development 3
      CSE 477 Web Application Architecture & Development 3
      CSE 480 Database Systems 3
      CSE 484 Information Retrieval 3
      CSE 491 Selected Topics in Computer Science 1-4
      MTH 451 Numerical Analysis I 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 telecommunications. 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 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 2015. 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.

*These courses may have prerequisites, which are not otherwise required in the program. Students should check course descriptions to ensure they are aware of prerequisites.
Computer Science
Requirements and Program Flow
These requirements are effective for students admitted to the Computer Science major beginning Fall 2008.
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
   - Integrative Studies in Social Sciences (ISS) 8
   - Bioscience (one of the following):
     - BS 161, ENT 205, MMG 201, PLB 105, PSL 250, ZOL 141 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

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, Profssnlism and Cont. Issues 1
      - ECE 480 Senior Design (W) 4
   C. Select one of the following courses: (3)
      - CE 221 Statics 3
      - ME 201 Thermodynamics 3

4. 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.

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

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

7. 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

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

9. Communications / Signal Processing
   - ECE 442 Introduction to Communication Networks 3
   - ECE 457 Communication Systems 3
   - ECE 458 Communication Systems Laboratory 1
   - ECE 466 Digital Signal Processing and Filter Design 3

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

11. 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
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 & Analysis of Bioelectrical Systems 3

3. Complete at least 3 credits from 1) the list below or 2) any 400-level course listed above but not otherwise counted toward the concentration, or 3) other approved course such as ECE 490 or ECE 491 with biomedical engineering content.  (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

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, 2013. 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 2015
Electrical Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Electrical Engineering major beginning Fall 2013.

**FRESHMAN YEAR**

- **FALL Term 1**: EGR 100 - 2 Intro Engr Design
  - CEM 141 - 4 Gen Cem
  - Bioscience – 3/4 Choose 1 from approved list
  - ISS 2XX – 4 1st Int Soc Sci
  - ME 100 - 2 Electives
  - PHY 183 – 4 Physics I
  - MTH 132 - 3 Calc I
  - MTH 133 - 4 Calc II
  - MTH 234 - 4 Multivar Calc
  - MTH 235 - 3 Diff Equations
  - WRA XXX – 4 Univ Writing

- **SPRING Term 2**: CSE 220-3 Programming in C
  - ECE 101 - OR- Elective – 2/3
  - ECE 201 - 3 Circuits & Syst I
  - EGR 100 - 2 Intro Engr Design
  - ECE 202 - 3 Circuits & Syst II
  - ECE 203 - 1 Elect Crc & Sys Lab
  - ECE 205 - 4 Elc Flds & Waves I
  - ECE 230 - 3 Digital Logic Fund
  - ECE 280 - 3 Elec Engr Analy

**SOPHOMORE YEAR**

- **FALL Term 3**: CEM 161 – 1 (P: CEM 141/ concurrent) -OR- PHY 191 – 1 (P: PHY 183/ concurrent)
  - ME 201-3 (P: CEM 141, PHY 183, MTH 234/concurrent) - OR- CE 221 – 3 (P: PHY 183, MTH 234/ concurrent)
  - Elective – 3
  - ECE 313 - 3 Control Systems
  - ECE 302 - 3 Elec Circuits
  - ECE 305 - 4 Elc Flds & Waves I

- **SPRING Term 4**: CSE 220-3 Programming in C
  - ECE 101 - OR- Elective – 2/3
  - ECE 201 - 3 Circuits & Syst I
  - ECE 303 – 1 Electronics Lab
  - ECE 280 - 3 Elec Engr Analy
  - ECE 305 - 4 Elc Flds & Waves I
  - Elective – 3

**JUNIOR YEAR**

- **FALL Term 5**: ISS 2XX – 4 1st Int Soc Sci
  - ME 201-3 (P: CEM 141, PHY 183, MTH 234/concurrent) - OR- CE 221 – 3 (P: PHY 183, MTH 234/ concurrent)
  - Elective – 3
  - ECE 313 - 3 Control Systems
  - ECE 302 - 3 Elec Circuits
  - ECE 305 - 4 Elc Flds & Waves I

- **SPRING Term 6**: CSE 220-3 Programming in C
  - ECE 101 - OR- Elective – 2/3
  - ECE 201 - 3 Circuits & Syst I
  - ECE 303 – 1 Electronics Lab
  - ECE 280 - 3 Elec Engr Analy
  - ECE 305 - 4 Elc Flds & Waves I
  - Elective – 3

**SENIOR YEAR**

- **FALL Term 7**: Elective – 3
  - ECE 366 - 3 Intro to Sig Proc
  - Mjr Elect #1 – 3/4 Choose 1 from approved list
  - Mjr Elect #2 – 3/4 Choose 1 from approved list
  - Mjr Elect #3 – 3/4 Choose 1 from approved list

- **SPRING Term 8**: Elective – 3
  - ECE 366 - 3 Intro to Sig Proc
  - Mjr Elect #1 – 3/4 Choose 1 from approved list
  - Mjr Elect #2 – 3/4 Choose 1 from approved list
  - Mjr Elect #3 – 3/4 Choose 1 from approved list

**LEGEND**

- Prerequisite
- Prerequisite or Concurrent

Last Revised: July 2013
# Environmental Engineering

1. **University Requirements**: (23)
   - Writing, Rhetoric and American Cultures (WRA) 4
   - Integrative Studies in Humanities (IAH) 8
   - Integrative Studies in Social Sciences (ISS) 8
   - Bioscience (one of the following):
     - BS 181, ENT 205, MMG 201
     - PLB 105, PSL 250, ZOL 141 3-4

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

3. **Major Requirements**: (65-73)
   A. Complete all of the following courses: (44)
      - BS 162 Organismal and Population Biology 3
      - CE 221 Statics 3
      - CE 271 Introduction to Civil Engineering 4
      - CE 272 Civil and Environmental Engr Analysis 3
      - CE 321 Introduction to Fluid Mechanics 4
      - CE 495 Senior Design in Civil Engineering 4
      - CEM 161 Chemistry Laboratory I 1
      - CHE 201 Materials and Energy Balances 3
      - ENE 280 Principles of Environ Engr and Science 3
      - ENE 421 Engineering Hydrology 3
      - ENE 480 Environmental Measurements Lab 1
      - ENE 481 Environ Chem: Equilibrium Concepts 3
      - ENE 483 Water & Wastewater Engr 3
      - ENE 487 Microbiology for Environ Science & Engr 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 Chem 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 the Great Lakes Region 3

E. **Major Tracks**: (12-18)
   - Complete the requirements of one of the tracks below.

   **Geo-environmental Engineering Track**: (17)
   - CE 312 Soil Mechanics 4
   - CE 337 Civil Engineering Materials I 4
   - CE 418 Geotechnical Engineering 3
   - CE 485 Landfill Design 3
   - ME 222 Mechanics of Deformable Solids 3

   **Water Resources Track**: (13)
   - ENE 422 Applied Hydraulics 3
   - GLG 411 Hydrogeology 3
   - GLG 412 Glacial Geology & Rcrd of Climate Chng 4
   - GLG 421 Environmental Geochemistry 3

   **General Track**: (12)
   1. Complete at least one of the following courses: (3)
      - CE 485 Landfill Design 3
      - ENE 422 Applied Hydraulics 3
   2. Additional credits to total 12 in the track, from technical courses at the 300 level or above, approved by the Department. Courses should be selected to provide some focus related to an application area of environmental engineering.

   Other Electives (Variable)
   - The requirements listed above apply to students admitted to the Department of Civil & Environmental Engineering (CEE) beginning Fall 2014. 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://www.egr.msu.edu/adcalendar/

**Total Credits Required for Degree** 128

Last revised November 2014
Environmental Engineering

These requirements are effective for students admitted to the Environmental Engineering major beginning Fall 2011.

FRESHMAN YEAR

FALL Term 1
- CEM 161 - 1
  Cem Lab I

SPRING Term 2
- CEM 142 - OR-
  CEM 152 - 3
  Gen Cem/Inorganc
- EGR 102 - 2
  Intro Engr Model
- MTH 132 - 3
  Calc I

SOPHOMORE YEAR

FALL Term 3
- CEM 141 - OR-
  CEM 151 - 4
  Gen Cem
- CE 271 - 3
  Intro to Civil Engr
- PHY 183 - 4
  Physics I
- WRA XXX - 4
  Univ Writing
- MTH 133 - 4
  Calc II

SPRING Term 4
- BS 161 - 3
  Cell & Molec Biol
- GLG 201-OR
  GLG 301 - 3/4
  Earth/Grt Lakes Geology (GLG 301 has MTH 132 prereq)
- CE 272 - 3
  CE/ENE Analysis
- CE 221 - 3
  Statics
- IAH 201-210
  1st Int Arts & Hum
- EGR 100 - 2
  Intro Engr Design
- EGR 102 - 2
  Intro Engr Model
- MTH 134 - 4
  Multivar Calc
- MTH 234 - 4
  Multivar Calc
- PHYS 184 - 4
  Physics II
- ISS 2XX - 4
  1st Int Soc Sci

JUNIOR YEAR

FALL Term 5
- BS 162 - 3
  Org & Pop Biol
- ENE 280 - 3
  Prn of Env Engr
- ENE 481 - 1
  Env Measurmnts Lab
- ENE 480 - 1
  Env Engr Hydro
- ENE 482 - 3
  Microbio for Env Sci & Engr
- CHE 201 - 4
  (P: CHE 201)
  or
  ME 201-3 (P: CEM 141; MTH 234/ Conc; PHY 183)
  Thermodynamics

SPRING Term 6
- Major Track Course - 3/4
- Major Track Course - 3/4
- Major Track Course - 3/4
- ENE 480 - 1
  Env Measurmnts Lab
- ENE 482 - 3
  Microbio for Env Sci & Engr
- Major Track Course - 3/4
- Major Track Course - 3/4
- Elective – Var X crs of Gen Elecs
- CE 272
  CE/ENE Analysis
- CEM 142 - OR-
  CEM 152 - 3
  Gen Cem/Inorganc

FALL Term 7
- Major Track Course - 3/4
- Elective – Var X crs of Gen Elecs
- CEM 141 - OR-
  CEM 151 - 4
  Gen Cem
- EGR 102 - 2
  Intro Engr Model
- MTH 132 - 3
  Calc I

SPRING Term 8
- Major Track Course - 3/4
- Elective – Var X crs of Gen Elecs
- CE 272
  CE/ENE Analysis
- CEM 142 - OR-
  CEM 152 - 3
  Gen Cem/Inorganc

LEGEND

- Prerequisite
- Prerequisite or Concurrent
- Dashed box: Course may be taken either Fall or Spring
- Rounded box: Offered only in the semester listed (excluding summer)

Last Revised: Mar 2012
Materials Science and Engineering
Sample Program

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

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 4
   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
      CEM 152 Principles of Chemistry 3
      CEM 161 Chemistry Laboratory I 1
      *ECE 345 Electronic Instrumentation and 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 and 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 Metallurgy 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
   ME 495 Tissue Mechanics 3
   MSE 425 Biomaterials and Biocompatibility 3
   ZOL 341 Fundamental Genetics 4

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
   ME 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
   ME 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 Alum Alloys 3

*To enroll MSE 426 & MSE 477, enroll in ME 426 & ME 477
*ECE 302 and ECE 303 may be substituted for ECE 345
Materials Science and Engineering

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  Intermed Mechanics of Deformable Solids  3
   ME 475  Computer Aided Design of Structures  3
   ME 477  Manufacturing Processes  3
   MSE 465  Design and Application of Egr. Materials  3
   MSE 476  Phys Metallurgy of Ferrous and Alum Alloys  3
   MSE 481  Spectroscopic and 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 Prncpls in Polymrs & Mats Sys  3
   MSE 426  Introduction to Composite Materials  3
   MSE 460  Electronic Structure & Bonding in Materials & Devices  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.

Total Credits Required for Degree  128

The requirements listed above apply to students admitted to the major of Materials Science and Engineering in the Department of Chemical Engineering and Materials Science (CHEMS) beginning Fall, 2014. The Department of Chemical Engineering and Materials Science constantly reviews program requirements and reserves the right to make changes as necessary. Consequently, each student is strongly encouraged to consult with his/her adviser to obtain assistance in planning an appropriate schedule of courses. Students who have questions about Materials Science and Engineering should contact Chemical Engineering and Materials Science Department Advising Office, 3508 Engineering Building, phone (517) 432-1352. For scheduling academic appointments visit: https://www.egr.msu.edu/adcalendar/

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

Last Revised May 2015
Materials Science and Engineering

Prerequisite Flowchart

These requirements are effective for students admitted to the Materials Science and Engineering major beginning Fall 2008.

LEGEND

Prerequisite

Prerequisite or Concurrent

“P”: Prerequisite

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

Last Revised: May 2014
# Mechanical Engineering

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

### 1. University Requirements: (23-24)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing, Rhetoric and American Cultures (WRA)</td>
<td>4</td>
</tr>
<tr>
<td>Integrative Studies in Humanities (IAH)</td>
<td>8</td>
</tr>
<tr>
<td>Integrative Studies in Social Sciences (ISS)</td>
<td>8</td>
</tr>
<tr>
<td>Bioscience (one of the following): BS 161, ENT 205, MMG 201, PLB 105, PSL 250, ZOL 141</td>
<td>3-4</td>
</tr>
</tbody>
</table>

### 2. College Requirements: (30)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 141 General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>EGR 100 Introduction to Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td>EGR 102 Introduction to Engineering Modeling</td>
<td>2</td>
</tr>
<tr>
<td>MTH 132 Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>MTH 133 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MTH 234 Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MTH 235 Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>PHY 183 Physics for Scientists &amp; Engineers I</td>
<td>4</td>
</tr>
<tr>
<td>PHY 184 Physics for Scientists &amp; Engineers II</td>
<td>4</td>
</tr>
</tbody>
</table>

### 3. Major Requirements: (64)

#### A. Complete all of the following courses: (52)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 221 Statics</td>
<td>3</td>
</tr>
<tr>
<td>CEM 161 Chemistry Laboratory I</td>
<td>1</td>
</tr>
<tr>
<td>ECE 345 Electronic Instrumentation and Systems</td>
<td>3</td>
</tr>
<tr>
<td>MSE 250 Materials Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>STT 351 Probability and Statistics for Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 280 Graphic Communications</td>
<td>2</td>
</tr>
<tr>
<td>ME 201 Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 222 Mechanics of Deformable Solids</td>
<td>3</td>
</tr>
<tr>
<td>ME 332 Fluid Mechanics (W)</td>
<td>4</td>
</tr>
<tr>
<td>ME 361 Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 371 Mechanical Design I</td>
<td>3</td>
</tr>
<tr>
<td>ME 391 Mechanical Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 410 Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 412 Heat Transfer Laboratory (W)</td>
<td>2</td>
</tr>
<tr>
<td>ME 451 Control Systems (W)</td>
<td>4</td>
</tr>
<tr>
<td>ME 461 Mechanical Vibrations (W)</td>
<td>3</td>
</tr>
<tr>
<td>ME 471 Mechanical Design II</td>
<td>3</td>
</tr>
<tr>
<td>ME 481 Mechanical Engr Design Projects (W)</td>
<td>3</td>
</tr>
</tbody>
</table>

#### B. Senior Electives: (9)

Complete a minimum of nine credits from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 416 Computer Ast Design of Thermal Sys</td>
<td>3</td>
</tr>
<tr>
<td>ME 417 Design of Alternative Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 422 Introduction to Combustion</td>
<td>3</td>
</tr>
<tr>
<td>ME 423 Intermed Mech of Deformable Solids</td>
<td>3</td>
</tr>
<tr>
<td>ME 425 Experimental Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 426 Introduction to Composite Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 440 Aerospace Engineering Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>ME 442 Turbomachinery</td>
<td>3</td>
</tr>
<tr>
<td>ME 444 Automotive Engines</td>
<td>3</td>
</tr>
<tr>
<td>ME 445 Automotive Powertrain Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 456 Mechatronic System Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 464 Intermediate Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 465 Computer Aided Optimal Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 475 Computer Aided Design of Structures</td>
<td>3</td>
</tr>
<tr>
<td>ME 477 Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>ME 478 Product Development</td>
<td>3</td>
</tr>
<tr>
<td>ME 490 Independent Study in Mechanical Engr</td>
<td>1-4</td>
</tr>
<tr>
<td>ME 491 Selected Topics in Mechanical Engr</td>
<td>1-4</td>
</tr>
<tr>
<td>ME 494 Biofluid Mechanics and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 495 Tissue Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

#### C. Design-Intensive courses. Complete a minimum of three additional credits from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 416 Computer Ast Design of Thermal Sys</td>
<td>3</td>
</tr>
<tr>
<td>ME 417 Design of Alternative Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 442 Turbomachinery</td>
<td>3</td>
</tr>
<tr>
<td>ME 445 Automotive Powertrain Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 456 Mechatronic System Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 465 Computer Aided Optimal Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 475 Computer Aided Design of Structures</td>
<td>3</td>
</tr>
<tr>
<td>ME 497 Biomechanical Design in Product Dev</td>
<td>3</td>
</tr>
</tbody>
</table>
Concentrations:
The Department offers concentrations in biomechanical engineering, 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.

Biomechanical Engineering Concentration (16)
To earn a Bachelor of Science degree in Mechanical Engineering with a biomechanical 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):
- 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

ME 490 and ME 491 may be used, subject to Department approval.

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

- 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

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:

All of the following courses (10):
- EC 210 Economics Principles Using Calculus 3
- ME 372 Machine Tool Laboratory 1
- ME 477 Manufacturing Processes 3
- ME 478 Product Development 3

Select one of the following courses (3):
- CHE 472 Composite Materials Processing 3
- ECE 415 Computer Aided Manufacturing 3
- ME 426 Introduction to Composite Materials 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., and 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.

Other Electives (Variable)

Total Credits Required for Degree 128

The requirements listed on opposite page apply to students admitted to the major of Mechanical Engineering in the Department of Mechanical Engineering beginning Fall 2014. 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.
Mechanical Engineering
Prerequisite Flowchart
These requirements are effective for students admitted to the Mechanical Engineering major beginning Summer 2011.