MATERIALS ENGINEERING

For the undergraduate curriculum in materials engineering leading to the degree bachelor of science. The Materials Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org/. Materials engineering is a broadly-based discipline relating the composition, structure, and processing of materials to their properties, uses and performance. Materials engineering includes a variety of traditional and modern technologies involving metals, ceramics, polymers, composites, and electronic materials.

Because of its interdisciplinary nature, career opportunities for materials engineers bridge all industrial and government sectors including: materials based technologies (materials production), communication/information technologies (semiconducting materials, fiber optics), medical/environmental technologies (biomedical, energy production, waste containment), nanotechnologies, consumer products (building and construction, durable goods), and transportation industries (automotive, aerospace).

Student Learning Outcomes

Graduates of the Materials Engineering curriculum should have, at the time of graduation:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Educational Objectives

Upon graduation, students should be able to:

- practice materials engineering in a broad range of industries including materials production, semiconductors, medical/environmental, consumer products, and transportation products
- engage in advanced study in materials and related or complementary fields

Graduates in materials engineering are able to apply scientific and engineering principles to select or design the best materials to solve engineering problems. They are also able to control the microstructure of materials through processing to optimize properties and performance. They are skilled in creative, independent problem solving under time and resource constraints. Graduates have the opportunity to gain experience in materials engineering practice through cooperative work experience or internships in industry, national laboratories, or other funded research. Graduates can develop a global perspective of engineering through various study abroad opportunities supported by the department. Classes provide hands-on skills with a broad range of modern materials processing and characterization equipment and methods.

A degree in materials engineering relies on a strong foundation of math, chemistry and physics. The core materials courses include fundamentals of materials, kinetics and thermodynamics, mechanical properties, computational methods, design, and professional practice experience. Students tailor their programs to their goals and interests through the selection of a specialization from the three available: ceramic materials, metallic materials and polymeric materials. Additional technical electives can be taken in other areas of interest. The breadth and depth of the program provide excellent preparation for both immediate entry into industry or further study in graduate school.

Curriculum in Materials Engineering

Administered by the Department of Materials Science and Engineering.

Leading to the degree bachelor of science.

Total credits required: 128 cr. Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs.

International Perspectives: 3 cr.
U.S. Diversity: 3 cr.
Communication Proficiency/Library requirement:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication (Must have a C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Introduction to College Level Research</td>
<td>1</td>
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Complete one of the following courses (Must earn a grade of C or better) 3
ENGL 302  Business Communication
ENGL 309  Proposal and Report Writing
ENGL 314  Technical Communication

**Advanced Communication Courses: 6 cr.**
ENGL 250  Written, Oral, Visual, and Electronic Composition
(Must have a C or better in this course)

Complete one of the following courses (Must earn a grade of C or better)
ENGL 314  Technical Communication
ENGL 309  Proposal and Report Writing
ENGL 302  Business Communication

**General Education Electives: 12 cr.**
Complete 12 cr. from approved list with a minimum of 3 cr. from 200+ level courses and maximum of 9 cr from the same designator.

**Basic Program: 24 cr.**
A minimum GPA of 2.00 is required for this set of courses. (Please note that transfer course grades will not be calculated into the Core/Specialization GPA.)

**Math and Physical Science: 18 cr.**
CHEM 177  General Chemistry I
or CHEM 167  General Chemistry for Engineering Students
ENGL 150  Critical Thinking and Communication (Must have a C or better in this course)
ENGR 101  Engineering Orientation
ENGR 160  Engineering Problems with Computer Applications Laboratory
LIB 160  Introduction to College Level Research
MATH 165  Calculus I
MATH 166  Calculus II
PHYS 231  Introduction to Classical Physics I
PHYS 231L  Introduction to Classical Physics I Laboratory

**Materials/Specialties Engineering Core: 47 cr.**
A minimum average GPA of 2.00 is required for this set of courses.
(please note that transfer course grades will not be calculated into the Core/Specialization GPA.)

MAT E 170  Numeric, Symbolic, and Graphical Methods for Materials Engineering
MAT E 214  Structural Characterization of Materials
MAT E 215  Introduction to Materials Science and Engineering I
MAT E 215L  Introduction to Materials Science and Engineering I - Lab
MAT E 216  Introduction to Materials Science and Engineering II
MAT E 216L  Introduction to Materials Science and Engineering II - Lab
MAT E 311  Thermodynamics in Materials Engineering
MAT E 314  Kinetics and Phase Equilibria in Materials
MAT E 317  Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials
MAT E 319  Mechanics of Structures and Materials
MAT E 413  Materials Design and Professional Practice I
MAT E 414  Materials Design and Professional Practice II
MAT E 418  Mechanical Behavior of Materials

Students must choose one from the three areas of specialization (12 cr.): ceramic, metallic or polymeric materials.

**Total Credits**

The courses below meet the specialization requirement. Students select one of the following tracks (ceramics, metals, polymers):

**Ceramic Materials:**
MAT E 321  Introduction to Ceramic Science
MAT E 322  Introduction to Ceramic Processing
MAT E 425  Glass Science and Engineering
MAT E 433  Advanced Ceramics and Electronic Materials

**Metallic Materials:**
MAT E 341  Metals Processing
MAT E 342  Structure/Property Relations in Nonferrous Metals
MAT E 443  Physical Metallurgy of Ferrous Alloys
MAT E 444  Corrosion and Failure Analysis

**Polymeric Materials:**
MAT E 350  Polymers and Polymer Engineering.
MAT E 351  Introduction to Polymeric Materials
MAT E 453  Physical and Mechanical Properties of Polymers  3
MAT E 454  Polymer Composites and Processing  3

Other Courses: 21 cr.
STAT 305  Engineering Statistics  3
In-department electives from list of materials courses  2  6
Technical electives from approved departments  2  12
Total Credits  21

Seminar/Co-op/Internships
Co-op and internships are optional
MAT E 301  Materials Engineering Professional Planning  R

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.
3. See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

Note: A Mat E student may take up to 6 credit hours from General Education electives on a P/NP basis, except for courses used to meet the U.S. Diversity and International Perspectives requirements. S/F courses (different from P/NP) will be considered for these requirements on a course-by-course basis.

See also: A 4-year plan of study grid showing course template by semester.

Materials Engineering, B.S.

First Year

Fall
Credits  Spring  Credits
CHEM 177  4  CHEM 178  3
CHEM 177L  1  CHEM 178L  1
ENGR 101  3  MATH 166  4
ENGR 160  3  Gen Ed Elective  3
MATH 165  4  US Diversity  3
LIB 160  1

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Second Year

Fall
Credits  Spring  Credits
MATH 265  4  MAT E 301  R

MAT E 215  3  MATH 267  4
MAT E 215L  1  MAT E 214  3
PHYS 231  4  MAT E 216  3
PHYS 231L  1  MAT E 216L  1
ENGL 250  3  PHYS 232  4
PHYS 232L  1

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Third Year

Fall
Credits  Spring  Credits
MAT E 311  3  MAT E 314  3
MAT E 317  3  MAT E 319  3
Specialization  3  Specialization  3
Materials Elective  3  STAT 305  3
Technical Elective  3  International Perspective  3

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Fourth Year

Fall
Credits  Spring  Credits
MAT E 413  3  MAT E 414  3
MAT E 418  3  Specialization  3
Specialization  3  Materials Elective  3
Technical Elective  3  Technical Elective  3
Technical Writing  3  Technical Elective  3
Gen Ed Elective  3

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Areas of specialization:

- Ceramic Materials: 321, 322, 425, 433
- Metallic Materials: 341, 342, 443, 444
- Polymeric Materials: 350, 351, 453, 454

The MSE Department offers B.S./M.S. and B.S./M.Eng. concurrent enrollment programs. Students accepted into a concurrent degree program may apply up to 6 credits of major or non-major graduate credit to both the B.S. degree and the relevant graduate degree (M.S. or M.Eng.). Admission to the B.S./M.S. program requires major professor sponsorship. Assistantships are not available for B.S./M.Eng. students. See the Graduate College Handbook for more details concerning application procedures. Undergraduate students should visit with both their academic advisor and the MSE Director of Graduate Education to discuss interest in a concurrent program, learn more about blending the undergraduate and graduate curricula, and to obtain copies of the application forms.

- Eligibility – Undergraduate students who will have earned 90 credits toward the BS Mat E degree by the time of concurrent enrollment are eligible to apply for a concurrent program.
• Admission Requirements – All regular MSE Graduate Program admission criteria (https://www.grad-college.iastate.edu/academics/programs/apresults.php?id=75) apply.

• Application Process – Applications for concurrent enrollment are not submitted through the Graduate College online application system. Rather, completed (paper) application packages should be submitted directly to the MSE Graduate Program Coordinator.

• Applications are accepted anytime.

• Application Package – The application package must include the following materials:
  • The ISU Concurrent Enrollment application form (“Concurrent Enrollment for Undergraduate Student Wishing to Pursue a Graduate Certificate or Degree”).
  • MSE Concurrent Enrollment Request form
  • Resume/CV
  • GRE test score report (include paper report and have scores transmitted electronically)
  • Three letters of recommendation

The MSE Department also offers a B.S. MAT E and MBA concurrent enrollment program in collaboration with the Ivy College of Business. For more information about this program, please visit: https://www.ivybusiness.iastate.edu/full-time-concurrent-mba/.