

# 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: advanced manufacturing, materials for energy and power, biomaterials and biomedical technology, functional materials and devices, nanomaterials and coatings, durable goods, infrastructure, and vehicle technologies (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

Within a few years of completing the Materials Engineering degree program, our graduates are expected to:

- *Work*-competently engage in professional employment, applying knowledge and skills related to the structure, properties, processing, and performance of materials.
- *Learn*-invest in broad life-long learning activities, such as advanced academic or professional degree programs, practical training, professional development, and leadership training.
- *Serve*-actively contribute to professional communities in their chosen career paths, including professional societies, advisory boards, standards and regulatory boards, and internal company organizations.

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. 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 immediate entry into industry, further study in graduate school, as well as many other unique career paths (i.e. law, military service, art conservation, museum conservatorship, etc).

## 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.**<sup>1</sup>

**U.S. Diversity: 3 cr.**<sup>1</sup>

**Communication Proficiency/Library requirement:**

ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
LIB 160	Introduction to College Level Research	1
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)	3
Complete one of the following courses (Must earn a grade of C or better)		3
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<sup>2</sup>.

**Basic Program: 24 cr.**<sup>3</sup>

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 Basic Program GPA.) See Requirement for Entry into Professional Program in College of Engineering Overview section.

CHEM 177	General Chemistry I	4
or CHEM 167	General Chemistry for Engineering Students	
ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGR 101	Engineering Orientation	R
ENGR 160	Engineering Problems with Computer Applications Laboratory <sup>3</sup>	3
LIB 160	Introduction to College Level Research	1
MATH 165	Calculus I	4
MATH 166	Calculus II	4
PHYS 231	Introduction to Classical Physics I	4

PHYS 231L	Introduction to Classical Physics I Laboratory	1
<b>Total Credits</b>		<b>24</b>

**Math and Physical Science: 18 cr.**

CHEM 177L	Laboratory in General Chemistry I	1
CHEM 178	General Chemistry II	3
CHEM 178L	Laboratory in College Chemistry II	1
MATH 265	Calculus III	4
MATH 267	Elementary Differential Equations and Laplace Transforms	4
PHYS 232	Introduction to Classical Physics II	4
PHYS 232L	Introduction to Classical Physics II Laboratory	1
<b>Total Credits</b>		<b>18</b>

**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	3
MAT E 214	Structural Characterization of Materials	3
MAT E 215	Introduction to Materials Science and Engineering I	3
MAT E 215L	Introduction to Materials Science and Engineering I - Lab	1
MAT E 216	Introduction to Materials Science and Engineering II	3
MAT E 216L	Introduction to Materials Science and Engineering II - Lab	1
MAT E 311	Thermodynamics in Materials Engineering	3
MAT E 314	Kinetics and Phase Equilibria in Materials	3
MAT E 317	Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials	3
MAT E 319	Mechanics of Structures and Materials	3
MAT E 413	Materials Design and Professional Practice I	3
MAT E 414	Materials Design and Professional Practice II	3
MAT E 418	Mechanical Behavior of Materials	3
Students must choose one from the three areas of specialization (12 cr.): ceramic, metallic or polymeric materials.		12

**Total Credits** **47**

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	3
MAT E 322	Introduction to Ceramic Processing	3
MAT E 425	Glass Science and Engineering	3
MAT E 433	Advanced Ceramics and Electronic Materials	3

**Metallic Materials:**

MAT E 341	Metals Processing	3
MAT E 342	Structure/Property Relations in Nonferrous Metals	3
MAT E 443	Physical Metallurgy of Ferrous Alloys	3
MAT E 444	Corrosion and Failure Analysis	3

**Polymeric Materials:**

MAT E 350	Polymers and Polymer Engineering.	3
MAT E 351	Introduction to Polymeric Materials	3
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 <sup>2</sup>		6
Technical electives from approved departments <sup>2</sup>		12
<b>Total Credits</b>		<b>21</b>

**Seminar/Co-op/Internships**

Co-op and internships are optional

MAT E 301	Materials Engineering Professional Planning	R
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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.
2. Choose from department approved list (<https://www.mse.iastate.edu/files/2019/08/UG-HANDBK-2019-2020-revised-08-19-19.pdf>).
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. (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegeofengineering/materialsengineering/#fouryearplantext>)

Materials Engineering, B.S.

**First Year**

Fall	Credits Spring	Credits
CHEM 177	4 CHEM 178	3
CHEM 177L	1 CHEM 178L	1
ENGL 150	3 MATH 166	4
ENGR 101	R MAT E 170	3
ENGR 160	3 Gen Ed Elective	3
MATH 165	4 US Diversity	3
LIB 160	1	
	<b>16</b>	<b>17</b>

**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
	<b>16</b>	<b>16</b>

**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
	<b>15</b>	<b>15</b>

**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
	<b>15</b>	<b>18</b>

### 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 concurrent enrollment program opportunities for students wishing to enroll in either the M.S. degree program or the M. Eng. degree program during the final stages of their B.S. program completion. Minimum admission requirements for these concurrent programs are the same as those for the regular M.S. and M. Eng. admission. (See MSE Graduate admission requirements (<https://www.grad-college.iastate.edu/academics/programs/apresults.php?id=75>.) Concurrently enrolled students are considered graduate students for official enrollment and tuition/fee purposes. MSE students concurrently enrolled as B.S./M.S. students are eligible for Graduate Research Assistantships (GRA), but these require Major Professor sponsorship and are not guaranteed with admission to the program. 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.
- **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
  - 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/>.