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, https://www.abet.org (https://www.abet.org/), under the commission's General Criteria and Program Criteria for Materials (1), Metallurgical (2), Ceramics (3) and Similarly Named Engineering Programs. 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 another 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. [1]
U.S. Diversity: 3 cr. [1]
Communication Proficiency/Library requirement:

ENGL 1500	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGL 2500	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
LIB 1600	Introduction to College Level Research	1
Complete one of the following courses (Must earn a grade of C or better)		3
ENGL 3020	Business Communication	
ENGL 3090	Proposal and Report Writing	
ENGL 3140	Technical Communication	

Advanced Communication Courses: 6 cr.

ENGL 2500	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 3140	Technical Communication	
ENGL 3090	Proposal and Report Writing	
ENGL 3020	Business Communication	

General Education Electives: 12 cr.

Complete 12 cr. from approved list with a minimum of 3 cr. from 2000+ level courses and maximum of 9 cr. from the same designator[2].

Basic Program: 24 cr. [3]

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 1770	General Chemistry I	4
or CHEM 1670	General Chemistry for Engineering Students	
ENGL 1500	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGR 1010	Engineering Orientation	
ENGR 1600	Engineering Problems with Computer Applications Laboratory [3]	3
LIB 1600	Introduction to College Level Research	1
MATH 1650	Calculus I	4
MATH 1660	Calculus II	4
PHYS 2310	Introduction to Classical Physics I	4
PHYS 2310L	Introduction to Classical Physics I Laboratory	1
Total Credits		**24**

Math and Physical Science: 18 cr.

CHEM 1770L	Laboratory in General Chemistry I	1
CHEM 1780	General Chemistry II	3
CHEM 1780L	Laboratory in College Chemistry II	1
MATH 2650	Calculus III	4
MATH 2670	Elementary Differential Equations and Laplace Transforms	4
PHYS 2320	Introduction to Classical Physics II	4
PHYS 2320L	Introduction to Classical Physics II Laboratory	1
Total Credits		**18**

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.)

MATE 1700	Numeric, Symbolic, and Graphical Methods for Materials Engineering	3
MATE 2140	Structural Characterization of Materials	3
MATE 2150	Introduction to Materials Science and Engineering I	3
MATE 2150L	Introduction to Materials Science and Engineering I - Lab	1
MATE 2160	Introduction to Materials Science and Engineering II	3
MATE 2160L	Introduction to Materials Science and Engineering II - Lab	1
MATE 3110	Thermodynamics in Materials Engineering	3
MATE 3140	Kinetics and Phase Equilibria in Materials	3
MATE 3170	Introduction to Electronic Properties of Materials	3
MATE 3190	Mechanics of Structures and Materials	3
MATE 4130	Materials Design and Professional Practice I	3
MATE 4140	Materials Design and Professional Practice II	3
MATE 4180	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:

MATE 3210	Introduction to Ceramic Science	3
MATE 3220	Introduction to Ceramic Processing	3

MATE 4250	Glass Science and Engineering	3
MATE 4330	Advanced Ceramics and Electronic Materials	3

Metallic Materials:

MATE 3410	Metals Processing	3
MATE 3420	Structure/Property Relations in Nonferrous Metals	3
MATE 4430	Physical Metallurgy of Ferrous Alloys	3
MATE 4440	Corrosion and Failure Analysis	3

Polymeric Materials:

MATE 3500	Polymers and Polymer Engineering.	3
MATE 3510	Introduction to Polymeric Materials	3
MATE 4530	Physical and Mechanical Properties of Polymers	3
MATE 4540	Polymer Composites and Processing	3

Other Courses: 21 cr.

STAT 3050	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

MATE 3010	Materials Engineering Professional Planning

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 MATE 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 1770	4	CHEM 1780	3
CHEM 1770L	1	CHEM 1780L	1
ENGL 1500	3	MATH 1660	4
ENGR 1010	R	MATE 1700	3
ENGR 1600	3	Gen Ed Elective	3
MATH 1650	4	US Diversity	3
LIB 1600	1		
	16		**17**

Second Year

Fall	Credits	Spring	Credits
MATH 2650	4	MATE 3010	R
MATE 2150	3	MATH 2670	4
MATE 2150L	1	MATE 2140	3
PHYS 2310	4	MATE 2160	3
PHYS 2310L	1	MATE 2160L	1
ENGL 2500	3	PHYS 2320	4
		PHYS 2320L	1
	16		**16**

Third Year

Fall	Credits	Spring	Credits
MATE 3110	3	MATE 3140	3
MATE 3170	3	MATE 3190	3
Specialization	3	Specialization	3
Materials Elective	3	STAT 3050	3
Technical Elective	3	International Perspective	3
	15		**15**

Fourth Year

Fall	Credits	Spring	Credits
MATE 4130	3	MATE 4140	3
MATE 4180	3	Specialization	3
Specialization	3	Materials Elective	3
Technical Elective	3	Technical Elective	3
Technical Writing	3	Technical Elective	3
		Gen Ed Elective	3
	15		**18**

Areas of specialization:

- Ceramic Materials: 3210, 3220, 4250, 4330
- Metallic Materials: 3410, 3420, 4430, 4440
- Polymeric Materials: 3500, 3510, 4530, 4540

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 B.S. MATE 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. MATE 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/.