What is Materials Science and Engineering?

Materials Science & Engineering is one of the most rapidly growing and enabling areas in science and engineering. Success in engineering stronger, faster, lighter, smaller, and better materials is rooted asking and answering questions like:

- How are materials structured on the atomic, nanometer (one billionth of a meter), and micrometer (one millionth of a meter) scales?
- How does structure of a material determine its properties, characteristics, and performance?
- How can materials be grown, synthesized, and processed to have the structure and properties that are desired and,
- How can new materials be discovered or created?
- How can newly discovered materials and materials phenomena be exploited to create new technologies that serve our societies and environment?

What do MS&E Graduates Do?

The discovery of new materials and improvement of existing ones are crucial to bettering our quality of life and solving critical technological and societal problems. Making safe, fuel efficient vehicles requires lightweight, strong materials. Improving the performance of jet engines requires new materials that can be used at high temperature. Increasing the computing capabilities of microprocessors requires improved materials for use in ever smaller integrated circuits. Developing new fuels and new sources of energy involve designing new materials for energy conversion and transmission. Integration of advanced capabilities in electronics with medicine or the environment requires the development of new materials systems with that exhibit high performance and stability in harsh environments. These challenges are among the many types that materials scientists and engineers take on in their

Who Are Materials Scientists and Engineering?

Students who both enjoy the sciences and are interested in applications in real world technologies should consider a curriculum and career in MS&E. Materials scientists and engineers approach problem solving much like their title suggests, sometimes seeking scientific understanding, sometimes seeing an engineering solution, and most of the time integrating both strategies. And they are active, creative, fun-loving contributors!

Left: UW-MS&E Materials Advantage Student Chapter members on a plant trip to Skana Aluminum in Manitowoc, WI. Right: Chapter members demonstrating at the 2013 UW Engineering Expo.
BS in Materials Science & Engineering (MS&E)
Curriculum and Opportunities for Undergraduate Students

Flexible Curriculum
The MS&E curriculum is designed to provide comprehensive coverage of the fundamental principles of the materials discipline. The materials core courses build upon concepts learned in underpinning chemistry, physics and biology courses with modern treatments of materials structure, properties, processing, and design. With the guidance of a department advisor, students can design a set of seven elective technical courses to explore a specific area in which they have particular interest or extend their knowledge across the broad field of materials science and engineering.

Elective Emphasis Areas
Examples of areas in which students can focus their studies through coordinated sets of electives include, among others:

- Materials for Energy Applications
- Computation and Simulation
- Structural Materials
- Nanomaterials and Nanotechnology
- Polymer Materials
- Biomaterials
- Materials for Electronics and Communications
- Broad-Based Materials Education

Scholarships
The Department of Materials Science and Engineering offers a broad range of scholarship support to students who have matriculated in the undergraduate degree programs. MS&E Department scholarships are based on merit, including GPA and contributions to the community. Applications are due at the end of each spring semester. Contact Cindy Rothwell at cynthia.rothwell@wisc.edu with questions regarding the application process.

Internships, Co-ops and Research
A great way to gain on-the-job and research experience is to participate in an internship, co-op or research opportunity. Up to 3 credits of MSAE 001 or research credit can count toward Emphasis Electives requirement. The experience gained is even more valuable. Contact Engineering Career Services for more information on co-op and internships.

Student Organizations
Many department students participate in the Materials Advantage student organization, which focuses on pre-professional activities for materials students. Materials students also have contributed materials expertise as partners in other campus student organizations, including Clean Snowmobile, Concrete Canoe, SWE (Society for Women Engineers) and the Hmong Association of Engineers, among others.

Advising Information–
Jen Brown
Room 170, 1410 Engineering Drive
(608)-262-3471
jennifer.brown@wisc.edu

For additional information, please reference to our website: https://www.engr.wisc.edu/department/materials-science-engineering/
Materials Science and Engineering BS Curriculum Flow Chart

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**Mathematics Foundations**
- Fall: Math 221 Calc I
- Spring: Math 222 Calc II (Math 221)

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**Physics Foundations**
- Fall: Physics I Phys 201, 207 or 247 (Math 221)
- Spring: Physics II Phys 202, 208 or 248 (Phys I)

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**Chemistry Foundations**
- Fall: General Chemistry Chem 109 or 103 & 104

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**Structure-Property Rel. Areas**
- Fall: MSE 351 Intro MSE (General Chemistry)
- Spring: MSE 352 Phys Mat (MSE 351)
- Fall: MSE 359 ODE’s (Math 222)
- Spring: Statistics 324 (Math 222)

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**Materials Courses**
- Fall: MSE 360 Intro Lab
- Spring: MSE 361 Lab 2 (MSE 350, 352 Concur)
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)
- Fall: MSE 362 Lab 3 (MSE 361)
- Spring: MSE 333 Micro-Processing (MSE 332)
- Fall: MSE 361 Concur
- Spring: MSE 331 Transport (MSE 330)
- Fall: MSE 362 Lab 3 (MSE 361)
- Spring: MSE 332 Macro-Processing (MSE 330)
- Fall: MSE 360 Intro Lab
- Spring: MSE 361 Lab 2 (MSE 350, 352 Concur)
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)

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**Professional Skills**
- Fall: EPD 155 (Comm A)

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**Liberal Studies**
- Fall: Liberal Studies
- Spring: Liberal Studies
- Fall: Liberal Studies
- Spring: Liberal Studies
- Fall: Liberal Studies
- Spring: Liberal Studies

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**Liberal Studies**
- Fall: Liberal Studies
- Spring: Liberal Studies
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- Spring: Liberal Studies

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**Emphasis Areas**
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)
- Fall: MSE 360 Intro Lab
- Spring: MSE 361 Lab 2 (MSE 350, 352 Concur)
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)
- Fall: MSE 360 Intro Lab
- Spring: MSE 361 Lab 2 (MSE 350, 352 Concur)
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)
- Fall: MSE 360 Intro Lab
- Spring: MSE 361 Lab 2 (MSE 350, 352 Concur)
- Fall: MSE 330 Thermo (Chemistry & Math 222)
- Spring: MSE 332 Macro-Processing (MSE 330)

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**Eng and Society Elective**
- Fall: Eng and Society Elective
- Spring: EPD 397 Technical Writing

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**Tech Emphasis Elective**
- Fall: Tech Emphasis Elective
- Spring: Tech Emphasis Elective
- Fall: Tech Emphasis Elective
- Spring: Tech Emphasis Elective
- Fall: Tech Emphasis Elective
- Spring: Tech Emphasis Elective

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**Credits**
- 16-18
- 15-17
- 17
- 15
- 14-17
- 15-16
- 16
- 15-17

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*It is possible to fulfill the subject requirements with 123 credits of course work. Free electives credits encourage students to choose electives based on content and personal interest rather than credit load. 128 credits of coursework are required for the degree.*
## Materials Science and Engineering BS Degree Requirements

for students beginning in or after Fall 2011

### Underpinning Mathematics/Science: (min 40 cr)

**Mathematics (16 cr)**
- Math 221 Calculus and Analytical Geometry
- Math 222 Calculus and Analytical Geometry
- Math 234 Calculus-Functions of Several Variables
- Math 319 Ordinary Differential Equations (DEQs)
  or Math 320 Linear Algebra and DEQs

**Statistics (3 cr)**
- Stat 324 Introductory Applied Statistics for Engineers

**Physics (10 cr)**
- Phys 201 or Phys 207 or Phys 247 General Physics I
  or EMA 201 and EMA 202
- Phys 202 or Phys 208 or Phys 248 General Physics II

**Chemistry (min 8 cr)**
- Chem 109 Advanced General Chemistry
  or Chem 103 & 104 General Chemistry
- Chem 343 Introductory Organic Chemistry
  or Chem 341, also Intro Organic Chemistry

### Science Elective (min 3 cr)

Select one of:
- Chem 311 Chemistry Across the Periodic Table
- Chem 327 Fundamentals of Analytical Science
- Chem 329 Fundamentals of Analytical Science
- Chem 345 Intermediate Organic Chemistry
- Geol 203 Earth Materials
- Phys 205 Modern Physics for Engineers
- Phys 235 Introduction to Solid State Electronics
- Phys 241 Intro to Modern Physics
- Phys 244 Intro to Modern Physics
- Biology 101 Animal Biology
- Biology 151 Introductory Biology
- Zoology 153

### Engineering Electives: (min 7 cr)

**Intro to Engineering Elective (min 1 cr)**
Select one course from the CoE pre-approved list of Introduction to Engineering courses.

**Engineering Foundations Elective (min 3 cr).**
Select one of:
- CBE 255 Introduction to Chemical Process Modeling
- CS 302 Intro to Object Oriented Programming
- CS 310 Problem Solving Using Computers
- ECE 230 Circuit Analysis
- ECE 376 Electrical and Electronic Circuits
- EMA 303 Mechanics of Materials
- Phys 321 Electric Circuits and Electronics
- Stat 424 Statistical Experimental Design for Eng’s

**Engineering and Society Elective. (3 cr):**
Select one of:
- Biology 260 Introductory Ecology, 3 cr
- CEE 491 Legal Aspects of Engineering
- Envir St 171 Global Change
- Envir St 343 Environmental Economics
- Envir St 367 Renewable Energy Systems
- Envir St 410 Minerals as a Public Problem
- Envir St 411 Energy Resources
- ISyE 313 Engineering Economic Analysis
- ISyE 349 Introduction to Human Factors
- Philos 241 Introduction to Ethics
- Philos 243 Ethics in Business
- Philos 341 Contemporary Moral Issues

### MSE Disciplinary Core Courses: (40 cr)
- MSE 330 Thermodynamics of Materials
- MSE 331 Transport Phenomena in Materials
- MSE 332 Macroprocessing of Materials
- MSE 333 Microprocessing of Materials
- MSE 351 Mat Sci-Structure Property Relationships
- MSE 352 Materials Science-Transformation of Solids
- MSE 360 Materials Laboratory I
- MSE 361 Materials Laboratory II
- MSE 362 Materials Laboratory III
- MSE 421 Introduction to Polymer Materials
- MSE 441 Deformation of Solids
- MSE 451 Introduction to Ceramic Materials
- MSE 456 Electrical, Optical and Magnetic Properties
- MSE 470 Capstone Project I
- MSE 471 Capstone Project II

### Materials Emphasis Electives: (15 cr)
Select 6 credits of MSE courses numbered 400 or above. These courses constitute the MSE portion of the Emphasis Electives on the curriculum flow chart.

Select 9 additional credits of science and engineering coursework. These can come from MS&E courses numbered 400 or above, other engineering courses numbered 300 or above, science courses numbered 300 or above, or up to 3 credits of MS&E 001 Co-op.

Taken together, the above 15 credits of courses constitute the MSE Emphasis Electives on the curriculum flow chart. MS&E advisor approval of the set of selections is required. Course sets may be broad-based or concentrated in a sub-field of materials science and engineering. See department for example materials emphasis elective course sets.

### Additional College and University Requirements: (23 cr)

**Communications (5 cr)**
- EPD 397 Technical Communication
- EPD 155 or other Comm A course

**Liberal Studies Electives (16 cr).**
Same as College of Engineering Liberal Studies Elective requirements.

### Credit Minimum for Graduation: 128 cr

The above subject requirements can be met with 123 credits of UW courses. Students must complete 128 credits of course work to earn the Bachelor of Science degree. The 5 elective credits maybe earned by choosing elective courses that carry more credits than the requirement’s minimum credit load or by taking any additional courses of the student’s choice.

### Notes:
- Except for the liberal studies requirements, the same course credits may be applied to only degree elective requirement. MS&E follows the College of Engineering policies with regard to application of liberal studies credits across the liberal studies requirements.
- Students who completed Stat 242 prior to entry into the MSE degree program may use it to fulfill the statistics requirement. All other students must take Stat 324. This exception is made because students cannot receive credit for Stat 242 and Stat 324 simultaneously.