MATERIALS ENGINEERING

For the undergraduate curriculum in materials engineering leading to the degree bachelor of science. This curriculum is accredited under the General Criteria and the Materials Engineering Program Criteria 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).

The objectives of the materials engineering program are to produce graduates who:

- 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 will have gained experience in materials engineering practice through cooperative work experience or internships in industry, national laboratories, or other funded research work. They will have 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.

The department also offers a cooperative education program that combines classroom learning with work experience.

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.

U.S. Diversity: 3 cr. 1

Communication Proficiency/Library requirement:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication (grade of C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition (grade of C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
<td>1</td>
</tr>
<tr>
<td>One of the following (must have a grade of C or better in this course)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
- ENGL 302  | Business Communication                            |        |
- ENGL 309  | Proposal and Report Writing                        |        |
- ENGL 314  | Technical Communication                            |        |
- JL MC 347 | Science Communication                              |        |

General Education Electives: 15 cr.

Complete 12 cr. from approved list with a maximum of 9 cr. of 100-level courses. 2 Also complete the one selected course (3 cr.) from the four choices shown above to complete your communication proficiency requirement (must have a grade of C or better in this course).

Basic Program: 27 cr.

Complete with minimum GPA of 2.00 in this set of courses, including transfer courses. See Requirement for Entry into Professional Program in College of Engineering Overview section.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>CHEM 177</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>or CHEM 167</td>
<td>General Chemistry for Engineering Students</td>
<td></td>
</tr>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Orientation</td>
<td>R</td>
</tr>
<tr>
<td>ENGR 160</td>
<td>Engineering Problems with Computer Applications</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
<td>1</td>
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<tr>
<td>MATH 165</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 166</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Classical Physics I</td>
<td>5</td>
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</table>

Total Credits 27

Math and Physical Science: 18 cr.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CHEM 177L</td>
<td>Laboratory in General Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 178</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 178L</td>
<td>Laboratory in College Chemistry II</td>
<td>1</td>
</tr>
<tr>
<td>MATH 265</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 267</td>
<td>Elementary Differential Equations and Laplace</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Transforms</td>
<td></td>
</tr>
<tr>
<td>PHYS 222</td>
<td>Introduction to Classical Physics II</td>
<td>5</td>
</tr>
</tbody>
</table>

Total Credits 18

Materials/Specialties Engineering Core: 44 cr.

Complete with minimum GPA of 2.00, including transfer courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>MAT E 214</td>
<td>Structural Characterization of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MAT E 215</td>
<td>Introduction to Materials Science and Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

1. Specials in U.S. Diversity required in Basic Program.
2. Internship or Cooperative experience.
3. Laboratory component for the course.

Iowa State University – 2016-2017
# Materials Engineering, B.S.

## First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>CHEM 177</td>
<td>4</td>
<td>CHEM 178</td>
<td>3</td>
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<tr>
<td>CHEM 177L</td>
<td>1</td>
<td>CHEM 178L</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 150</td>
<td>3</td>
<td>MATH 166</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>0</td>
<td>Gen Ed Elective</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 160</td>
<td>3</td>
<td>Gen Ed Elective</td>
<td>3</td>
</tr>
<tr>
<td>MATH 165</td>
<td>4</td>
<td>US Diversity</td>
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<tr>
<td>LIB 160</td>
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<td></td>
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## Second Year

<table>
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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 265</td>
<td>4</td>
<td>MATH 267</td>
<td>4</td>
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<tr>
<td>MAT E 215</td>
<td>3</td>
<td>MAT E 214</td>
<td>3</td>
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<tr>
<td>MAT E 215L</td>
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<td>MAT E 216</td>
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<tr>
<td>PHYS 221</td>
<td>5</td>
<td>MAT E 216L</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>3</td>
<td>PHYS 222</td>
<td>5</td>
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<td>16</td>
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</tbody>
</table>

## Third Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MAT E 311</td>
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<td>MAT E 314</td>
<td>3</td>
</tr>
<tr>
<td>MAT E 317</td>
<td>3</td>
<td>MAT E 316</td>
<td>3</td>
</tr>
<tr>
<td>E M 274</td>
<td>3</td>
<td>E M 324</td>
<td>3</td>
</tr>
<tr>
<td>Materials Elective</td>
<td>3</td>
<td>Specialization</td>
<td>3</td>
</tr>
<tr>
<td>Specialization</td>
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<td>Technical Elective</td>
<td>3</td>
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<tr>
<td></td>
<td>15</td>
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<td>18</td>
</tr>
</tbody>
</table>

## Fourth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MAT E 401</td>
<td>0</td>
<td>MAT E 414</td>
<td>3</td>
</tr>
<tr>
<td>MAT E 413</td>
<td>3</td>
<td>Specialization</td>
<td>3</td>
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<tr>
<td>MAT E 418</td>
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<td>Technical Elective</td>
<td>3</td>
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<tr>
<td>Specialization</td>
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<td>Technical Writing</td>
<td>3</td>
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<tr>
<td>Materials Elective</td>
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<td>Free Elective</td>
<td>3</td>
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</tbody>
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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.


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 9 credit hours from General Education and free electives on a P/NP basis, except for courses used to meet the diversity and international perspectives requirement. 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. (p. 2)
Technical Elective 3

15

Total Credits: 128

Areas of specialization:
- Ceramic Materials: 321, 322, 425, 433
- Metallic Materials: 341, 343, 442, 444
- Polymeric Materials: Chem 331, 351, 453, 454

Well qualified juniors in materials engineering who are interested in graduate study may apply for concurrent enrollment during their senior year in the Graduate College to simultaneously pursue both bachelor of science and master of science degrees. See Materials Science and Engineering (http://catalog.iastate.edu/collegeofengineering/materialsscienceandengineering) for more information.

Courses primarily for undergraduates:

MAT E 214: Structural Characterization of Materials
(2-2) Cr. 3. F.S.
Prereq: MAT E 215, credit or enrollment in PHYS 221
Structural characterization of ceramic, electronic, polymeric and metallic materials. Techniques include optical and electron microscopy, x-ray diffraction, and thermal analysis. Identification of materials type, microstructure, and crystal structure.

MAT E 215: Introduction to Materials Science and Engineering I
(3-0) Cr. 3. F.S.
Prereq: Math 165 AND (CHEM 177 or CHEM 167)
Materials Engineering majors only. Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Only one of Mat E 215, 273, or 392 may count toward graduation.

MAT E 215L: Introduction to Materials Science and Engineering I - Lab
(0-2) Cr. 1. F.S.
Prereq: Credit or enrollment in MAT E 215 or MAT E 273 or MAT E 392
Materials Engineering majors only. Laboratory exercise in materials.

MAT E 216: Introduction to Materials Science and Engineering II
(3-0) Cr. 3. F.S.
Prereq: MAT E 215, Chem 178, Credit or enrollment in PHYS 222
Materials Engineering majors only. Fundamentals of ceramic, polymeric, and composite materials; degradation, electronic, thermal, magnetic, and optical properties of materials. Materials for energy, biomaterials, and nanomaterials.

MAT E 216L: Introduction to Materials Science and Engineering II - Lab
(0-2) Cr. 1. F.S.
Prereq: Credit or enrollment in 216
Materials Engineering majors only. Laboratory exercise in materials.

MAT E 220: Global Sustainability
(Cross-listed with ANTHR, ENV S, GLOBE, M E, SOC, T SC). (3-0) Cr. 3. F.S.
An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

MAT E 273: Principles of Materials Science and Engineering
(3-0) Cr. 3. F.S.S.
Prereq: Sophomore classification; CHEM 167 or CHEM 177; MATH 165

MAT E 298: Cooperative Education
Cr. R. F.S.S.S.
Prereq: Permission of department and Engineering Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.

MAT E 311: Thermodynamics in Materials Engineering
(3-0) Cr. 3. F.
Prereq: CHEM 178, credit or enrollment in MAT E 216, PHYS 222, and MATH 267
Basic laws of thermodynamics applied to phase equilibria, transformations, and reactions in multicomponent multiphase material systems; Thermodynamic descriptions of heterogeneous systems; Binary and ternary phase diagrams; interfaces, surfaces, and defects.

MAT E 314: Kinetics and Phase Equilibria in Materials
(3-0) Cr. 3. S.
Prereq: MAT E 216, MAT E 311
Kinetic phenomena and phase equilibria relevant to the origins and stability of microstructure in metallic, ceramic and polymeric systems. Application of thermodynamics to the understanding of stable and metastable phase equilibria, interfaces and their effects on stability: defects and diffusion, empirical rate equations for transformation kinetics, driving forces and kinetics of nucleation, diffusional and diffusionless phase transformations.

MAT E 316: Computational Methods in Materials
(3-0) Cr. 3. S.S.S.
Prereq: MAT E 215
Use of mathematical and statistical computer tools for materials design and analysis. Applications of statistical principles to problems concerned with materials. Computer-assisted design of experiments.

MAT E 317: Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials
(3-0) Cr. 3. F.
Prereq: MAT E 216 and PHYS 222
MAT E 321: Introduction to Ceramic Science
(3-0) Cr. 3. F.
Prereq: MAT E 216

MAT E 322: Introduction to Ceramic Processing
(2-3) Cr. 3. S.
Prereq: MAT E 216, MAT E 321

MAT E 332: Semiconductor Materials and Devices
(Cross-listed with E E). (3-0) Cr. 3. S.
Prereq: PHYS 222; MAT E majors: MAT E 317; CPR E and E E majors: E E 230
Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's.

MAT E 334: Electronic & Magnetic Properties of Metallic Materials
(3-0) Cr. 3. S.
Prereq: MAT E 317

MAT E 341: Metals Processing
(2-2) Cr. 3. F.
Prereq: 215 or 273 or 392, Mat E majors only
Theory and practice of metal processing, including casting; powder metallurgy; additive manufacturing; rolling; forging; extrusion; drawing; material removal; joining; surface modification; and heat treatment. Use of processing software.

MAT E 343: Physical Metallurgy of Ferrous Alloys
(3-0) Cr. 3. S.
Prereq: 214, 215 or 273 or 392, credit or enrollment in 311
MAT E 394: Topics in Sustainable Engineering in Italy
(3-0) Cr. 3. S.
Prereq: Chem 167 or Chem 177
Fundamentals of sustainable engineering related to biofuels. Basics of food and biofuel chemistry and fluid dynamics. Preparation course for Italy as a case study for food and sustainable engineering. Orientation for summer study abroad program in Torino, Italy. Credit for graduation allowable only upon completion of the following summer’s offering of Mat E 316 taught in Italy, along with additional sustainability lessons/tours.

MAT E 396: Summer Internship
Cr. R. Repeatable. SS.
Prereq: Permission of department and Engineering Career Services
Summer professional work period.

MAT E 397: Engineering Internship
Cr. R. Repeatable. F.S.
Prereq: Permission of department and Engineering Career Services; junior classification
Professional work period, one semester maximum per academic year.

MAT E 398: Cooperative Education
Cr. R. F.S.SS.
Prereq: MAT E 298, permission of department and Engineering Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

MAT E 401: Materials Engineering Professional Planning
Cr. R. F.
Prereq: Senior classification in materials engineering
Preparation for a career in materials engineering or graduate school; experiential learning, resumes, interviewing, Myers-Briggs Type Indicator, leadership, international opportunities, professional ethics, graduate school preparation and opportunities, and alternative career paths (med school, law school, etc.). Offered on a satisfactory-fail basis only.

MAT E 413: Materials Design and Professional Practice I
(2-2) Cr. 3. F.
Prereq: Senior status in Mat E
Fundamentals of materials engineering design, information sources, team behavior, professional preparation, quantitative design including finite-element analysis and computer aided design, materials selection, informatics and combinatorial methods. Analysis of design problems, development of solutions, selected case studies. Oral presentation skills. Preparations for spring project.

MAT E 414: Materials Design and Professional Practice II
(2-2) Cr. 3. F.S.
Prereq: Senior status in Mat E
Integration of materials processing, structure/composition, properties and performance principles in materials engineering problems. Multiscale design of materials, materials processing, case studies including cost analysis, ethics, risk and safety. Team projects specified by either industry or academic partners. Written and oral final project reports.

MAT E 418: Mechanical Behavior of Materials
(3-0) Cr. 3. F.
Prereq: MAT E 216
Mechanical behavior of ceramics, metals, polymers, and composites. Relationships between materials processing and atomic aspects of elasticity, plasticity, fracture, and fatigue. Life prediction, stress-and failure analysis.

MAT E 425: Glass Science and Engineering
(2-3) Cr. 3. F.
Prereq: MAT E 216, MAT E 321
Composition, structure, properties manufacturing, and applications of inorganic glasses. Mechanical, structural, thermal, optical, ionic, electronic, and biological applications of inorganic glasses, especially silicate glasses. Contemporary topics in glass science and engineering such as glass optical fiber communication and flat panel display technologies. Laboratory exercises in the preparation and characterization of silicate glasses. Nonmajor graduate credit.

MAT E 432: Microelectronics Fabrication Techniques
(Dual-listed with M S E 532). (Cross-listed with E E). (2-4) Cr. 4.
Prereq: credit or enrollment in E E 332
Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

MAT E 433: Advanced Electronic Materials
(2-3) Cr. 3. S.
Prereq: MAT E 317

MAT E 442: Structure/Property Relations in Nonferrous Metals
(3-0) Cr. 3. F.
Prereq: MAT E 215 or 273 or 392
Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites.

MAT E 444: Corrosion and Failure Analysis
(2-2) Cr. 3. S.
Prereq: MAT E 215 or 273 or 392 and credit or enrollment in MAT E 418
Corrosion and corrosion control of metallic systems. Corrosion fundamentals, classification of different types of metallic corrosion, corrosion properties of various engineering alloys, corrosion control. Failure analysis. Characteristics of common types of metallic failures, case studies of failures, designing to reduce failure risk.

MAT E 449: Structural Health Monitoring
(Dual-listed with M S E 549). (Cross-listed with C E). (3-0) Cr. 3.
Prereq: Senior classification in Engineering or permission of instructor
Introductory and advanced topics in structural health monitoring (SHM) of aeronautical, civil, and mechanical systems. Topics include sensors, signal processing in time and frequency domains, data acquisition and transmission systems, design of integrated SHM solutions, nondestructive evaluation techniques, feature extraction methods, and cutting edge research in the field of SHM. Graduate students will have a supervisory role to assist students in 449 and an additional design project or more in-depth analysis and design.
MAT E 453: Physical and Mechanical Properties of Polymers
(2-3) Cr. 3. F.
Prereq: MAT E 351
Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing.

MAT E 454: Polymer Composites and Processing
(Dual-listed with M S E 554). (3-0) Cr. 3. S.
Prereq: MAT E 351
Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications.

MAT E 456: Biomaterials
(Dual-listed with M S E 556). (Cross-listed with B M E). (3-0) Cr. 3. F.
Prereq: MAT E 216 or MAT E 273 or MAT E 392
Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

MAT E 457: Chemical and Physical Metallurgy of Rare Earth Metals
(Dual-listed with M S E 557). (Cross-listed with B M E). (3-0) Cr. 3. F.
Prereq: MAT E 311 or CHEM 325 AND CHEM 324 or PHYS 322
Electronic configuration, valence states, minerals, ores, beneficiation, extraction, separation, metal preparation and purification. Crystal structures, phase transformations and polymorphism, and thermochemical properties of rare earth metals. Chemical properties: inorganic and organometallic compounds, alloy chemistry, nature of the chemical bonding. Physical properties: mechanical and elastic properties, magnetic properties, resistivity, and superconductivity.

MAT E 466: Multidisciplinary Engineering Design
(Cross-listed with A B E, AER E, B M E, CPR E, E E, ENGR, I E, M E). (1-4) Cr. 3. Repeatable. F.S.
Prereq: Student must be within two semesters of graduation and permission of instructor.
Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

MAT E 467: Multidisciplinary Engineering Design II
Prereq: Student must be within two semesters of graduation or receive permission of instructor.
Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

MAT E 481: Computational Modeling of Materials
(Dual-listed with M S E 581). (3-0) Cr. 3. F.
Prereq: Math 265 and (MatE 311 or Che 381 or Chem 325 or Phys 304)
Introduction to the basic methods used in the computational modeling and simulation of materials, from atomistic simulations to methods at the mesoscale. Students will be expected to develop and run sample programs. Topics to be covered include, for example, electronic structure calculations, molecular dynamics, Monte Carlo, phase-field methods, etc.

MAT E 488: Eddy Current Nondestructive Evaluation
(Dual-listed with M S E 588). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered odd-numbered years.
Prereq: MATH 265 and (MAT E 216 or MAT E 273 or E E 311 or PHYS 364)
Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

MAT E 490: Independent Study
Cr. arr. Repeatable.
Investigation of individual research or special topics.

MAT E 498: Cooperative Education
Cr. R. Repeatable. F.S.S.
Prereq: MAT E 398, permission of department and Engineering Career Services
Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.