



University Bulletin

Undergraduate Degree Programs

Materials Science and Engineering

University Park, College of Earth and Mineral Sciences (MATSE)

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The future can be appropriately termed the age of materials. In addition to the traditional engineering applications of metals, ceramics, semiconductors, and polymers, new materials and composites must be developed by materials scientists to aid progress in communications, computing, electronics, biomedicine, transportation, aerospace, defense, and the production and efficient use of energy.

Our curriculum is structured to support our Department mission of providing students with a well-rounded engineering education, with specific emphasis on materials science and engineering in order to meet the needs of industry, academia, and government; to conduct research at the frontiers of the field; and to provide an integrating and leadership role to the broad multi-disciplinary materials community.

The general objective of the undergraduate program is embedded in our mission statement. The Department expects its graduates will apply their knowledge of materials science to the synthesis, design, characterization, and engineering of new materials, and devices comprised of them, in industrial and laboratory settings. Our graduates will have the necessary skills and knowledge to excel in careers related to the entire life-cycle of materials, from raw materials production, to materials synthesis and processing, component design and development, manufacturing, use, reclamation, and recycling.

We expect that our graduates will practice in a wide range of materials-related positions, such as process and manufacturing engineers, technical sales representatives, quality control engineers, research engineers, metallurgists, ceramists, production and plant managers, consultants, etc. In addition, we expect that a substantial portion of our graduates will pursue graduate studies in technical and business-related disciplines, as well as participate in continuing education activities such as technical symposia, workshops, and short courses.

The educational objectives of the undergraduate program are embedded into our mission statement. We will provide and maintain a curriculum that will prepare our recent graduates to accomplish the following Program Educational Objectives:

1. Our graduates provide science and engineering leadership in international industrial, governmental, and academic settings, while serving both their profession and the public.
2. Our graduates are innovators in a wide variety of technical fields including, but not limited to, materials, energy, electronics, medicine, communications, transportation, and recreation.
3. Our graduates excel in careers related to the entire life cycle of materials, from synthesis and processing, through design and development, to manufacturing,

- performance, reclamation, and recycling.
4. Our graduates engage in lifelong learning activities which enhance their careers and provide flexibility to respond to changing professional and societal needs.

To achieve these objectives, students in Materials Sciences and Engineering begin with a background in basic chemistry, mathematics, and physics, which are the foundation for broad-based materials properties, processing, and applications courses. Commencing with their junior year, students take courses in Materials Science and Engineering and specialized courses in one of four options: Ceramic Science and Engineering, Electronic and Photonic Materials, Metals Science and Engineering, or Polymer Science and Engineering. The curricula integrate classroom instruction and laboratory experience, and culminate in a capstone research and design experience which is documented in the form of a thesis in the senior year.

The curricula for each of the options in Materials Science and Engineering are described in the following sections.

CERAMIC SCIENCE AND ENGINEERING OPTION

PROFESSOR DAVID J. GREEN, *Option Adviser*

This option covers the manufacture and usage of a wide variety of inorganic materials that usually include high temperatures. The program helps prepare students for operating, research, and development positions in all sections of the ceramic industry and for graduate studies. Graduates also find employment in many other industries that use ceramic materials, such as iron and steel, electrical and electronic, energy generation, automotive, aeronautical, and aerospace. Many find employment in industries that manufacture composite materials such as glass-ceramics, metal-ceramics, or glass-metal structures. The B.S. degree in this option is accredited by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410.347.7700 or [www.abet.org \(http://www.abet.org\)](http://www.abet.org).

For the B.S. degree in Materials Science and Engineering with an option in Ceramic Science and Engineering, a minimum of 127 credits is required.

ELECTRONIC AND PHOTONIC MATERIALS OPTION

PROFESSOR SUZANNE E. MOHNEY, *Option Adviser*

This option provides specialized courses dealing with the processing, properties, and performance of semiconductor, optoelectronic, and optical materials and devices. The graduates contribute in the electronics, telecommunications, and computer industries or pursue advanced studies in materials science and engineering. The B.S. degree in this option is accredited by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410.347.7700 or [www.abet.org \(http://www.abet.org\)](http://www.abet.org).

For the B.S. degree in Materials Science and Engineering with an option in Electronic and Photonic Materials, a minimum of 127 credits is required.

METALS SCIENCE AND ENGINEERING OPTION

PROFESSOR PAUL HOWELL, *Option Adviser*

The metals option provides an opportunity to explore a broad range of both scientific and engineering principles as applied to metals and alloys. A graduate of this option will thus typically apply basic concepts of chemistry, physics, or engineering science to problems concerning the processing or properties of metals. Although metallurgists are often employed by metals-producing industries, an increasingly large fraction are finding

employment in a diverse group of industries that use metals, such as those in the electronics or aerospace fields. Many graduates pursue advanced studies. The B.S. degree in this option is accredited by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410.347.7700 or www.abet.org (<http://www.abet.org>).

For the B.S. degree in Materials Science and Engineering with an option in Metals Science and Engineering, a minimum of 127 credits is required.

POLYMER SCIENCE AND ENGINEERING OPTION

PROFESSOR PAUL PAINTER, *Option Adviser*

This option allows the student to establish a firm foundation in the basic sciences and to apply this knowledge to a study of the synthesis, structure, and physical properties of synthetic and natural polymers.

Polymers are a major class of materials consisting of macromolecules of very high molecular weight. Polymers are pervasive in today's technological society and find numerous applications in such diverse fields as plastics, elastomers (rubber), adhesives, surface coatings (paints), biomaterials, textiles, paper, packaging, and composite materials.

This option helps prepare graduates for research, development, and technical sales positions in numerous materials and chemical industries that either produce or utilize polymers; or to proceed to advanced studies in polymer science or related technical fields. The B.S. degree in this option is accredited by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410.347.7700 or www.abet.org (<http://www.abet.org>).

For the B.S. degree in Materials Science and Engineering with an option in Polymer Science and Engineering, a minimum of 127 credits is required.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION 45 credits

(24 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)

(See description of General Education in front of *Bulletin*. Note The Accreditation Board for Engineering and Technology (ABET) does not permit the use of skills courses to satisfy the Arts category of General Education.)

FIRST-YEAR SEMINAR:

(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:

(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:

(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 106 credits

(This includes 24 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 9 credits of GWS courses.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 66 credits

PRESCRIBED COURSES (59 credits)

CHEM 110 GN(3), CHEM 111 GN(1), CHEM 112 GN(3), CHEM 113 GN(1), EM SC 100S GWS(3) [\[71\] \(#mnote71\)](#), ENGL 202C GWS(3), MATH 140 GQ(4), MATH 141 GQ(4), MATH 220 GQ(2-3), MATH 231(2), MATH 251(4), PHYS 211 GN(4), PHYS 212 GN(4), PHYS 214

GN(2) (Sem: 1-4)

I E 424(3), MATSE 201(3) [\[1\]\(#mnote01\)](#), MATSE 401(3) [\[1\]\(#mnote01\)](#), MATSE 436(3), MATSE 460(1), MATSE 462(1), MATSE 492W(3) [\[1\]\(#mnote01\)](#), MATSE 494W(2) (Sem: 5-8)

ADDITIONAL COURSES (6 credits)

CMPSC 201 GQ(3) or CMPSC 202 GQ(3), ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-4)

REQUIREMENTS FOR THE OPTION: 40 credits

CERAMIC SCIENCE AND ENGINEERING OPTION: (40 credits)

PRESCRIBED COURSES (31 credits)

E MCH 211(3) (Sem: 4)

MATSE 400(3) [\[1\]\(#mnote01\)](#), MATSE 402(3) [\[1\]\(#mnote01\)](#), MATSE 410(3), MATSE 411(3), MATSE 412(3), MATSE 413(3), MATSE 417(3), MATSE 430(3), MATSE 435(3), MATSE 468(1) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (9 credits)

Select 9 credits of technical electives in consultation with adviser (Students may apply 6 credits of ROTC and/or 3 credits of Cooperative Education Experience (ENGR X95 or SC X95)) (Sem: 5-8)

ELECTRONIC AND PHOTONIC MATERIALS OPTION: (40 credits)

PRESCRIBED COURSES (28 credits)

E SC 314(3), E E 441(3), MATSE 400(3) [\[1\]\(#mnote01\)](#), MATSE 402(3) [\[1\]\(#mnote01\)](#), MATSE 417(3), MATSE 430(3) [\[1\]\(#mnote01\)](#), MATSE 435(3), MATSE 450(3), MATSE 455(3), MATSE 463(1) (Sem: 5-8)

ADDITIONAL COURSES (3 credits)

MATSE 413(3) or PHYS 237(3) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (9 credits)

Select 9 credits of technical electives in consultation with adviser (Students may apply 6 credits of ROTC and/or 3 credits of Cooperative Education Experience (ENGR X95 or SC X95)) (Sem: 5-8)

METALS SCIENCE AND ENGINEERING OPTION: (40 credits)

PRESCRIBED COURSES (34 credits)

E MCH 210(5) (Sem: 4)

MATSE 400(3), MATSE 402(3) [\[1\]\(#mnote01\)](#), MATSE 410(3) [\[1\]\(#mnote01\)](#), MATSE 417(3), MATSE 421(3), MATSE 422(3), MATSE 425(3), MATSE 426(3), MATSE 430(3) [\[1\]\(#mnote01\)](#), MATSE 471(1), MATSE 472(1) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (6 credits)

Select 6 credits of technical electives in consultation with advisor. At least 3 credits must be in MATSE and 3 credits must be in the engineering sciences. (Students may apply 6 credits of ROTC and/or 3 credits of Cooperative Education Experience (ENGR X95 or SC X95)) (Sem: 5-8)

POLYMER SCIENCE AND ENGINEERING OPTION: (40 credits)

PRESCRIBED COURSES (31 credits)

CHEM 210(3), CHEM 212(3), CHEM 213(2) (Sem: 3-4)

MATSE 441(3) [\[1\]\(#mnote01\)](#), MATSE 443(3) [\[1\]\(#mnote01\)](#), MATSE 444(3), MATSE 445(3) [\[1\]\(#mnote01\)](#), MATSE 446(3), MATSE 447(3), MATSE 448(3), MATSE 473(1),

MATSE 474(1) (Sem: 5-8)

ADDITIONAL COURSES (3 credits)

MATSE 430(3) [1](#mnote01), or a 400 level engineering technical elective (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (6 credits)

Select 6 credits of technical electives in consultation with advisor. At least 3 credits must be in MATSE and 3 credits in the engineering sciences. (Students may apply 6 credits to ROTC and/or 3 credits of Cooperative Education Experience (ENGR X95 or SC X95)) (Sem: 5-8)

Note: Engineering students are expected to take at least one sequence of humanities, social science, or arts courses of either 6 or 9 credits that culminates in a higher-level course. Humanities, arts, and social science courses should compose an integral part of the engineering program and not be limited to a selection of unrelated introductory courses. Close consultation with advisers on these issues is warranted.

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.

[71] The following substitutions are allowed for students attending campuses where the indicated course is not offered: CAS 100 GWS or ENGL 202C GWS can be substituted for EM SC 100S GWS.

Last Revised by the Department: Spring Semester 2009

Blue Sheet Item #: 37-05-026

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UCA Revision #1: 8/9/06

UCA Revision #2: 7/30/07

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This is the official bulletin of The Pennsylvania State University. Programmatic expectations for General Education are those in effect at the time of admission to degree candidacy, and college and major requirements are those in effect at the time of entry to college and major. These are accurately indicated in each student's degree audit.

The University reserves the right to change the requirements and regulations listed here and to determine whether a student has satisfactorily met its requirements for admission or graduation, and to reject any applicant for any reason the University determines to be material to the applicant's qualifications to pursue higher education. Nothing in this material should be considered a guarantee that completion of a program and graduation from the University will result in employment.

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