

MICHIGAN STATE UNIVERSITY

February 8, 2012

MEMORANDUM

TO: Dr. Douglas Estry, Associate Provost for Undergraduate Education
and Dean of Undergraduate Studies

FROM: Dr. Linda O. Stanford, Associate Provost for Academic Services

RE: Request for a New Minor in Materials Science and Engineering
For Transmittal to the University Committee on Undergraduate Studies

The request referenced above is being sent to the University Committee on Undergraduate Studies in accordance with the *Bylaws for Academic Governance*, 4.4.

Response Requested:

Please ask the committee to consider the request referenced above and provide consultative commentary. Please mail the related materials referenced under the heading Attachments at the end of this memorandum to the committee members.

After receiving the committee's consultative response, the Provost will make a determination to forward or not to forward the request to the University Committee on Curriculum for its approval of curriculum and degree requirements.

If you have any questions, please call Joy Speas, University Curriculum Administrator, at 5-8420.

Thank you.

Attachments:

1. Request to Establish a New Academic Program form dated January 6, 2012: Minor in Materials Science and Engineering and attachments.



University Curriculum and Catalog

176 Administration Bldg.
East Lansing, MI
48824-1046

517-355-8420
Fax: 517-353-1935

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COLLEGE OF ENGINEERING

1. Request to establish a **Minor in Materials Science and Engineering** in the Department of Chemical Engineering and Materials Science. The University Committee on Undergraduate Studies (UCUS) will consider this request.

a. **Background Information:**

Materials have become an important issue across all fields of engineering. Students in mechanical engineering, electrical engineering, and other majors are expressing interest in obtaining a more detailed education in materials science.

b. **Academic Programs Catalog Text:**

The Minor in Materials Science and Engineering, which is administered by the Department of Chemical Engineering and Materials Science, provides students with a basic foundation in materials science that is applicable to many disciplines. The minor also offers opportunities for students to work in industry, research, or government, as well as to prepare for graduate study in materials science.

The minor is available as an elective to students in a bachelor's degree program in the College of Engineering, other than the Bachelor of Science Degree in Materials Science and Engineering. With the approval of the college, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree. At least 12 unique credits counted towards the requirements for a student's minor must not be used to fulfill the requirements for that student's major.

Students who plan to complete the requirements for the minor must apply to the Department of Chemical Engineering and Materials Science. To be accepted into the minor, the student must be admitted into the College of Engineering. Enrollment for some MSE courses may be limited. Application forms are available at www.chems.msu.edu.

Requirements for the Minor in Materials Science and Engineering

CREDITS

Complete 18 credits from the following:

- | | | | |
|----|---|---|---|
| 1. | Both of the following courses (6 credits): | | |
| | MSE 250 | Materials Science and Engineering | 3 |
| | MSE 360 | Fundamentals of Microstructural Design | 3 |
| 2. | One of the following courses (3 credits): | | |
| | MSE 260 | Electronic, Magnetic, Thermal and Optical Properties of Materials | 3 |
| | MSE 310 | Phase Equilibria in Materials | 3 |
| | MSE 320 | Mechanical Properties of Materials | 3 |
| | MSE 370 | Synthesis and Processing of Materials | 3 |
| 3. | Three of the following courses (9 credits): | | |
| | MSE 320 | Mechanical Properties of Materials | 3 |
| | MSE 370 | Synthesis and Processing of Materials | 3 |
| | MSE 410 | Materials Foundations for Energy Applications | 3 |
| | MSE 425 | Biomaterials and Biocompatibility | 3 |
| | MSE 451 | Spectroscopic and Diffraction Analysis of Materials | 3 |
| | MSE 454 | Ceramic and Refractory Materials | 3 |
| | MSE 460 | Electronic Structure and Bonding in Materials and Devices | 3 |
| | MSE 465 | Design and Application of Engineering Materials | 3 |
| | MSE 476 | Physical Metallurgy of Ferrous and Aluminum Alloys | 3 |
| | MSE 477 | Manufacturing Processes | 3 |

A course used to fulfill requirement 2. above may not be used to fulfill this requirement.

Effective Fall 2012.

View a Program		Main Menu
Joy Speas, RO	Friday, 1/6/2012	
Program Name: Minor in Materials Science and Engineering Degree: MNUN Sequence Number: 1	Program Request ID: 2116	
Effective Dates: Fall 2012 - Open Status: Interim Initial Action: New		
Requested Date: 11/29/2011 12:12:03 PM		
<p>1. Department/School/College: 16140 Department of Chemical Engineering and Materials Science</p> <p>2. Name of Program: Minor in Materials Science and Engineering</p> <p>3. Name of Degree: MNUN</p> <p>4. Type of Program: Minor</p> <p>5. Effective Start Semester: Fall 2012</p> <p>6. Target student audience for the program: Students in the College of Engineering</p> <p>7. Enrollment: What is the expected enrollment per year: 10 What is the minimum enrollment acceptable: 0</p> <p>8. Source of budget for the program: To align academic planning and curricular change, ALL requests for NEW funds must be included in the College's annual planning letter. Provost approval of new funds and the effective date for the new program must align. If funding is not approved, then the program request will not be forwarded to Faculty Senate. Internal reallocation If new funds, was this request included in the College's annual planning letter? Indicate yes or no. If no, then this is a department or college fund reallocation (If the program is implemented, no additional resources are required.).</p> <p>9. Projected Costs as compared to other programs in unit: Same</p> <p>10. Staff requirement: How many additional staff will be required: 0 Who will provide the primary instruction. Describe any external linkages(industry, government, etc.):</p>		

Existing faculty

11. Will additional equipment be required:

Approximate cost: 0

Source of funding:

12. Will additional library materials be required:

Approximate cost: 0

Source of funding: n/a

13. Will additional space be required:

Type:

Approximate amount:

14. If the program requirements contain a named concentration, do you wish for the concentration to be noted on the student's transcript?:

No

*in the
College of
Engineering
P. Tom Walcott
1-27-12*

Minor in Materials Science and Engineering

The Minor in Materials Science and Engineering is administered by the Department of Chemical Engineering and Materials Science. This minor will provide students with a basic foundation in materials science that is applicable to many disciplines. This will also provide opportunities for students working in industry, research, or government, as well as prepare students for graduate-level study in materials science. The minor is available as an elective to students who are enrolled in bachelor's degree programs at Michigan State University other than the Bachelor of Science Degree in Materials Science and Engineering. ~~With the approval of the department and college that administers the student's degree program, two courses (6 credits) that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.~~ At least 12 unique credits counted towards the requirements for a student's minor must not be used to fulfill the requirements for that student's major.

Students who plan to complete the requirements for the minor must apply to the Department of Chemical Engineering and Materials Science. To be accepted into the minor program, the student must be admitted into the MSU College of Engineering. Enrollment for some MSE courses may be limited. Application forms are available at www.chems.msu.edu.

Complete 18 credits in the Department of Chemical Engineering and Materials Science from the following:

1. The following courses (6 credits):
 - MSE 250 Materials Science and Engineering 3
 - MSE 360 Fundamentals of Microstructural Design* 3
2. One of the following courses (3 credits):
 - MSE 260 Electronic, Magnetic, Thermal and Optical Properties of Materials 3
 - MSE 310 Phase Equilibria in Materials 3
 - MSE 320 Mechanical Properties of Materials 3
 - MSE 370 Synthesis and Processing of Materials 3
3. Three of the following courses (9 credits):
 - MSE 320 Mechanical Properties of Materials 3
 - MSE 370 Synthesis and Processing of Materials 3
 - MSE 410 Materials Foundations for Energy Applications 3
 - MSE 425 Biomaterials and Biocompatibility 3
 - MSE 451 ^{Spectro}Microscopic and Diffraction Analysis of Materials 3
 - MSE 454 Ceramic and Refractory Materials 3
 - MSE 460 ^{Structure and}Electronic Bonding in Materials and Devices 3
 - MSE 465 Design and Application of Engineering Materials 3
 - MSE 476 Physical Metallurgy of Ferrous and Aluminum Alloys 3
 - MSE 477 Manufacturing Processes 3

* This course has a prerequisite of MSE 310, a course covering thermodynamics. For the minor, ME 201, CHE 321, PHY 215, or another similar course is also acceptable, but students will need to do some background study of regular solutions and phase diagrams covered in MSE 310 that are not covered elsewhere.

16. Are there admissions requirements for this program?:

Grade or grade-point average requirements and if so in which course(s), portfolio requirement, audition, essay, etc. If there are not admission requirements other than those required by the University policy indicate "none".

← Applicants must be admitted to other majors in the College of Engineering. Application must be submitted to the Department of Chemical Engineering and Materials Science prior to completing the last 12 credits of the minor.

DEPARTMENT LEVEL APPROVAL STATUS

Approved: Department of Chemical Engineering and Materials Science
1/6/2012 11:01:21 AM by Nicole Marshall for Martin Hawley, Chairperson

COLLEGE LEVEL APPROVAL STATUS

Approved: College of Engineering
1/6/2012 1:26:53 PM by Jamie Ramos for Thomas F. Wolff, Associate Dean

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DEPARTMENT of CHEMICAL ENGINEERING and MATERIALS SCIENCE

Martin Hawley, Chairperson

The undergraduate and graduate programs of the Department of Chemical Engineering and Materials Science have been training top-quality graduates for over 75 years. Graduates from the Department of Chemical Engineering and Materials Science are highly sought after for work on important societal problems. The faculty is dedicated to strong classroom instruction and world-class research focused in the areas of energy and sustainability, advanced materials and nanotechnology, and biotechnology and medicine.

UNDERGRADUATE PROGRAMS

Students in chemical engineering and materials science learn to convert low-value raw materials into high-value products. Students learn how to analyze and understand different processes and how, at the macroscopic and molecular levels these processes result in different properties in the final product. Emphasis is placed on developing students who understand the technical aspects of production, the environmental, economic, and societal impact of engineering, and who possess a desire for lifelong learning and growth. Optional concentrations are available for students to focus their programs of study on areas of particular interest.

Graduates are trained to succeed in multidisciplinary teams at the interfaces between disciplines. They work across a broad spectrum of fields including industrial chemicals, automotive, plastics, petroleum processing, pharmaceuticals, textiles, food, electronics, sensors, consumer goods, biomedical technology, and specialty materials of construction. Within these fields, our graduates are involved in research and development of products and processes, in the design and operation of manufacturing facilities, and in management and product quality control.

CHEMICAL ENGINEERING

Chemical engineers convert raw materials to finished products via pathways involving chemical and physical changes. The principles of mass, energy, and momentum conservation, chemical reactions, thermodynamics, and economics are applied to develop new products and to design and operate manufacturing facilities to produce products that benefit society. Chemical engineering principles are, in turn, based on the sciences of chemistry, biology, mathematics, and physics, which form the underlying foundation of the discipline.

Students in this degree program will study the application of chemical engineering principles to biochemical and biomedical systems, nanoscale devices, polymer processing, and novel energy systems. Principles of sustainability, environmentally-friendly "green" processing, entrepreneurship, and other emerging topics are also addressed in courses and concentrations.

The Bachelor of Science Degree program in Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

Requirements for the Bachelor of Science Degree in Chemical Engineering

- The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Chemical Engineering.

The University's Tier II writing requirement for the Chemical Engineering major is met by completing Chemical Engineering 316 and 433. Those courses are referenced in item 3. a. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

- The requirements of the College of Engineering for the Bachelor of Science degree. The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

- The following requirements for the major:

	CREDITS
a. All of the following courses:	58
BS 161 Cell and Molecular Biology	3
CEM 151 General and Descriptive Chemistry	4
CEM 152 Principles of Chemistry	3
CEM 161 Chemistry Laboratory I	1
CEM 162 Chemistry Laboratory II	1
CEM 351 Organic Chemistry I	3
CEM 352 Organic Chemistry II	3
CEM 355 Organic Laboratory I	2
CHE 201 Material and Energy Balances	3
CHE 210 Modeling and Analysis of Transport Phenomena	3
CHE 301 Chemical Engineering as a Profession	1
CHE 311 Fluid Flow and Heat Transfer	3
CHE 312 Mass Transfer and Separations	4
CHE 316 Laboratory Practice and Statistical Analysis	4
CHE 321 Thermodynamics for Chemical Engineering	4
CHE 431 Chemical Reaction Engineering	4
CHE 432 Process Analysis and Control	3
CHE 433 Process Design and Optimization I	4
CHE 434 Process Design and Optimization II	2
CHE 473 Chemical Engineering Principles in Polymers and Material Systems	3
b. One of the following:	4 or 6
(1) BMB 401 Comprehensive Biochemistry	4
(2) BMB 461 Advanced Biochemistry I	3
BMB 462 Advanced Biochemistry II	3
c. One of the following courses:	3
CHE 472 Composite Materials Processing	3
CHE 481 Biochemical Engineering	3
d. One of the following courses:	3
CEM 483 Quantum Chemistry	3
CEM 484 Molecular Thermodynamics	3
e. Technical Electives.	

Students must complete at least 6 credits of technically oriented subject-related courses approved by the student's advisor. Acceptable subjects include, but are not limited to, composites processing or biochemical engineering (in addition to that required in 3. c. above), electronic materials, environment, advanced mathematics, transport phenomena, advanced chemistry, foods, legal and regulatory issues, advanced materials, advanced biology, statistics, biomedical engineering, bioenergy, and polymers.

NOTE: Elective courses in item 3. e. must include at least 3 credits of engineering topics, which includes courses taught in the College of Engineering as well as courses taught in advanced mathematics, advanced chemistry, advanced biology, advanced statistics, and advanced physics. If Biochemistry and Molecular Biology 462 is taken to fulfill requirement 3.b. it will count as technical elective credit in item 3.e.

Concentrations in Chemical Engineering

In response to increasing interest in the application of chemical engineering principles to related fields, the Department of Chemical Engineering and Materials Science offers concentrations in biochemical engineering, bioenergy, biomedical engineering, environmental engineering, food science, and polymer science and engineering to students wishing an area of concentration in the degree. Concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree program in chemical engineering. The concentration will be noted on the student's transcript.

NOTE: Completing the Bachelor of Science degree in chemical engineering with a concentration may require more than 128 credits.

Biochemical Engineering

To earn a Bachelor of Science degree in Chemical Engineering with a biochemical engineering concentration, students must complete requirements 1., 2., 3. a., and 3. e. above and the following:

Both of the following courses:	6
CHE 481 Biochemical Engineering	3
MMG 301 Introductory Microbiology	3
One of the following:	4 or 6
(1) BMB 401 Comprehensive Biochemistry	4
(2) BMB 461 Advanced Biochemistry I	3
BMB 462 Advanced Biochemistry II	3

Two or three of the following courses. Students who chose BMB 401 above must complete three courses. Students who chose BMB 461 and 462 above must complete two courses:

BMB 829 Methods of Macromolecular Analysis and Synthesis	2
CHE 882 Advanced Biochemical Engineering	3
CHE 883 Multidisciplinary Bioprocessing Laboratory	3
MMG 409 Eukaryotic Cell Biology	3
MMG 421 Prokaryotic Cell Physiology	3
MMG 431 Microbial Genetics	3
MMG 445 Microbial Biotechnology (W)	3

Bioenergy

To earn a Bachelor of Science degree in Chemical Engineering with a bioenergy concentration, students must complete requirements 1., 2., 3. a., 3. b., 3. d., and 3. e. above and the following:

All of the following courses:	12
BE 469 Sustainable Bioenergy Systems	3
CHE 468 Biomass Conversion Engineering	3
CHE 481 Biochemical Engineering	3
CSS 467 Bioenergy Feedstock Production	3
One of the following courses:	3 or 4
AEC 829 The Economics of Environmental Resources	3
CHE 882 Advanced Biochemical Engineering	3
CHE 883 Multidisciplinary Bioprocessing Laboratory	3
GLG 471 Applied Geophysics	4
MC 450 International Environmental Law and Policy	3
MMG 445 Microbial Biotechnology (W)	3

Biomedical Engineering

To earn a Bachelor of Science degree in Chemical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., 3. a., 3. b., 3. d., and 3. e. above and the following:

All of the following courses:	9
CHE 481 Biochemical Engineering	3
MMG 409 Eukaryotic Cell Biology	3
PSL 431 Human Physiology I	3
Two of the following courses:	6 or 7
BMB 471 Biochemistry Laboratory (W)	3
CHE 883 Multidisciplinary Bioprocessing Laboratory	3
ME 494 Biofluid Mechanics and Heat Transfer	3
ZOL 341 Fundamental Genetics	4

Environmental

To earn a Bachelor of Science degree in Chemical Engineering with an environmental concentration, the student must complete requirements 1., 2., and 3. a., 3. b., 3. d., and 3. e. above and the following:

Both of the following courses:	6
CHE 481 Biochemical Engineering	3
ENE 280 Principles of Environmental Engineering and Science	3
Three of the following courses:	9
CE 485 Landfill Design	3
EEP 255 Ecological Economics	3
EEP 320 Environmental Economics	3
EEP 405 Corporate Environmental Management	3
ENE 481 Environmental Chemistry: Equilibrium Concepts	3
ENE 483 Water and Wastewater Engineering	3
ESA 200 Introduction to Environmental Studies and Agriscience	3
ESA 430 Environmental and Natural Resource Law	3
ZOL 446 Environmental Issues and Public Policy	3

Food Science

To earn a Bachelor of Science degree in Chemical Engineering with a food science concentration, students must complete requirements 1., 2., 3. a., 3. b., 3. c., 3. d., and 3. e. above and all of the following:

All of the following courses:	9
FSC 401 Food Chemistry	3
FSC 440 Food Microbiology	3
MMG 301 Introductory Microbiology	3
One of the following courses:	3 or 4
BE 477 Food Engineering: Fluids	3
BE 478 Food Engineering: Solids	3
FSC 325 Food Processing: Unit Operations	4
FSC 455 Food and Nutrition Laboratory	3
FSC 470 Integrated Approaches to Food Product Development	3

Polymer Science and Engineering

To earn a Bachelor of Science degree in Chemical Engineering with a polymer science and engineering concentration, students must complete requirements 1., 2., 3. a., 3. b., 3. d., and 3. e. above and all of the following:

All of the following courses:	10
CE 221 Statics	3
CHE 472 Composite Materials Processing	3
ME 222 Mechanics of Deformable Solids	4
Two of the following courses:	6 or 7
CHE 871 Material Surfaces and Interfaces	3
CHE 872 Polymers and Composites: Manufacturing, Structure and Performance	3
MSE 370 Physical Processing of Materials	3
MSE 426 Introduction to Composite Materials	3
PKG 323 Packaging with Plastics	4

MATERIALS SCIENCE and ENGINEERING

Materials Science and Engineering majors learn to select and create materials used to realize engineering designs in fields such as bioengineering, microelectronics and aerospace. They also learn how to manipulate the elements of matter into the atomic arrangements that insure efficient and cost-effective materials performance, demanded by today's advanced applications.

Through the core course work, students gain the scientific and engineering foundation needed to design metallic, ceramic, polymeric, and composite materials and, in turn, components manufactured from these materials. Students may enhance the knowledge they gain in metals, ceramics, and polymers by completing a concentration in biomedical materials, manufacturing, polymers, or metallurgy. Students may also choose to enroll in electives of complementary fields such as business, electronic materials or statistics.

The Bachelor of Science Degree program in Materials Science and Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

Requirements for the Bachelor of Science Degree in Materials Science and Engineering

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Materials Science and Engineering.
 The University's Tier II writing requirement for the Materials Science and Engineering major is met by completing Materials Science and Engineering 466. That course is referenced in item 3. a. below.
 Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1, under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.
2. The requirements of the College of Engineering for the Bachelor of Science degree.
 The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.
3. The following requirements for the major:

	CREDITS
a. All of the following courses:	41 to 44
CE 221 Statics	3
CEM 152 Principles of Chemistry	3
CEM 161 Chemistry Laboratory I	1
ECE 345 Electronic Instrumentation and Systems	3
ME 222 Mechanics of Deformable Solids	4
MSE 250 Materials Science and Engineering	3
MSE 310 Phase Equilibria in Materials	3
MSE 320 Mechanical Properties of Materials	3
MSE 331 Materials Characterization Methods I	1
MSE 350 Electronic Structure and Properties of Materials	3
MSE 360 Fundamentals of Microstructural Design	3
MSE 370 Physical Processing of Materials	3
MSE 381 Materials Characterization Methods II	2
MSE 466 Design and Failure Analysis (W)	3
MSE 477 Manufacturing Processes	3
STT 351 Probability and Statistics for Engineering	3
Electrical and Computer Engineering 302 and 303 may be substituted for Electrical and Computer Engineering 345.	
b. Two of the following courses:	6
MSE 454 Ceramic and Refractory Materials	3
MSE 465 Design and Application of Engineering Materials	3
MSE 476 Physical Metallurgy of Ferrous and Aluminum Alloys	3
c. Complete at least 5 credits from 400-level courses within the College of Engineering.	
d. Complete at least 7 credits in courses selected from a list of approved technical electives available from the Department of Chemical Engineering and Materials Science.	

Concentrations in Materials Science and Engineering

Students may elect to complete a more focused set of courses to enhance their ability to function at the interface with another scientific, engineering, or business discipline. Concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree in Materials Science and Engineering.

Completing the Bachelor of Science degree in Materials Science and Engineering with a concentration may require more than 128 credits. The concentration will be noted on the student's transcript.

Biomedical Materials Engineering

To gain interdisciplinary skills in human biology and earn a Bachelor of Science degree in Materials Science and Engineering with a biomedical materials engineering concentration, students must complete requirement 3. a. above and the following (25 credits):

1. All of the following courses (16 credits):

ANTR 350	Human Gross Anatomy and Structural Biology	3
CEM 351	Organic Chemistry I	3
ME 495	Tissue Mechanics	3
MSE 425	Biomaterials and Biocompatibility	3
ZOL 341	Fundamental Genetics	4
2. One of the following courses (3 credits):

MSE 454	Ceramics and Refractory Materials	3
MSE 465	Design and Application of Engineering Materials	3
MSE 476	Physical Metallurgy of Ferrous and Aluminum Alloys	3
3. At least 6 credits from a list of approved technical electives 6

Manufacturing Engineering

To gain interdisciplinary skills with business and design engineers for manufacturing projects and earn a Bachelor of Science degree in Materials Science and Engineering with a manufacturing engineering concentration, students must complete requirement 3. a. above and the following (18 credits):

1. All of the following courses (9 credits):

ECE 415	Computer Aided Manufacturing	3
ME 478	Product Development	3
MSE 465	Design and Application of Engineering Materials	3
2. Three of the following courses (9 credits):

GBL 323	Introduction to Business Law	3
MSE 426	Introduction to Composite Materials	3
MSE 454	Ceramic and Refractory Materials	3
MSE 476	Physical Metallurgy of Ferrous and Aluminum Alloys	3

Completion of this concentration fulfills requirement 2. of the admission requirements for the Master of Science degree in Manufacturing and Engineering Management offered by The Eli Broad College of Business.

Metallurgical Engineering

To enhance the student's ability to characterize, process, and design with metals in association with mechanical engineers and earn a Bachelor of Science degree in Materials Science and Engineering with a metallurgical engineering concentration, students must complete requirement 3. a. above and the following (18 credits):

1. All of the following courses (15 credits):

ME 423	Intermediate Mechanics of Deformable Solids	3
ME 475	Computer Aided Design of Structures	3
MSE 426	Introduction to Composite Materials	3
MSE 465	Design and Application of Engineering Materials	3
MSE 476	Physical Metallurgy of Ferrous and Aluminum Alloys	3
2. One of the following courses (3 credits):

ME 425	Experimental Mechanics	3
MSE 451	Microscopic and Diffraction Analysis of Materials	3

Polymeric Engineering

To gain interdisciplinary skills to facilitate interactions with chemical engineers and earn a Bachelor of Science degree in Materials Science and Engineering with a polymeric engineering concentration, students must complete requirement 3. a. above and the following (15 credits):

- All of the following courses (15 credits):
- | | | |
|---------|---|---|
| CEM 351 | Organic Chemistry I | 3 |
| CHE 311 | Fluid Flow and Heat Transfer | 3 |
| CHE 472 | Composite Materials Processing | 3 |
| CHE 473 | Chemical Engineering Principles in Polymers and Materials Systems | 3 |
| MSE 426 | Introduction to Composite Materials | 3 |

Insert (1)

MINOR IN MATERIALS SCIENCE AND ENGINEERING

The Minor in Materials Science and Engineering, which is administered by the Department of Chemical Engineering and Materials Science, provides students with a basic foundation in materials science that is applicable to many disciplines. The minor also offers opportunities for students to work in industry, research, or government, as well as to prepare for graduate study in materials science.

The minor is available as an elective to students in a bachelor's degree program in the College of Engineering, other than the Bachelor of Science Degree in Materials Science and Engineering. With the approval of the college, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree. At least 12 unique credits counted towards the requirements for a student's minor must not be used to fulfill the requirements for that student's major.

Students who plan to complete the requirements for the minor must apply to the Department of Chemical Engineering and Materials Science. To be accepted into the minor, the student must be admitted into the College of Engineering. Enrollment for some MSE courses may be limited. Application forms are available at www.chems.msu.edu.

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			CREDITS
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	MSE 360	Fundamentals of Microstructural Design	3
2.	One of the following courses (3 credits):		
	MSE 260	Electronic, Magnetic, Thermal and Optical Properties of Materials	3
	MSE 310	Phase Equilibria in Materials	3
	MSE 320	Mechanical Properties of Materials	3
	MSE 370	Synthesis and Processing of Materials	3
3.	Three of the following courses (9 credits):		
	MSE 320	Mechanical Properties of Materials	3
	MSE 370	Synthesis and Processing of Materials	3
	MSE 410	Materials Foundations for Energy Applications	3
	MSE 425	Biomaterials and Biocompatibility	3
	MSE 451	Spectroscopic and Diffraction Analysis of Materials	3
	MSE 454	Ceramic and Refractory Materials	3
	MSE 460	Electronic Structure and Bonding in Materials and Devices	3
	MSE 465	Design and Application of Engineering Materials	3
	MSE 476	Physical Metallurgy of Ferrous and Aluminum Alloys	3
	MSE 477	Manufacturing Processes	3
A course used to fulfill requirement 2. above may not be used to fulfill this requirement.			