MATERIALS SCIENCE AND BIOMEDICAL ENGINEERING

Phillis 177
715-836-5504
Department Website (https://www.uwec.edu/academics/college-arts-sciences/departments-programs/materials-science-biomedical-engineering/)

The Materials Science & Biomedical Engineering Department offers comprehensive majors in Materials Science, Materials Science & Engineering, and Biomedical Engineering. All three degree programs are designed to give students a strong foundation in fundamental sciences and mathematics.

The field of materials science and engineering is the study of “condensed matter” (that is, solids and liquids), and how an understanding of materials can be applied to fabricating devices and structures of utility. A relatively young discipline, materials science is an outgrowth of two traditional areas: the study of matter (and its structure-property relationship) that originated in chemistry and physics, and developments in various “materials” engineering fields (notably, microelectronics, metallurgy, ceramics, and plastics). More generally, materials scientists and materials engineers explore the interdependence of how a material is processed, its structure, and its properties, and how these impact material performance.

Biomedical engineering is also a relatively new area that explores the integration of engineering, technology and computation with the medical field. BME is a diverse discipline that covers specialties such as medical imaging, medical devices and instrumentation, cell and tissue engineering, 3D printing and biomaterials. The focus of this degree is designing and implementing new approaches that can help enhance disease diagnosis, improve disease management and lead to better treatments.

Department Honors in Materials Science & Biomedical Engineering

Eligibility – All students majoring in Materials Science, Materials Science and Engineering, or Biomedical Engineering are invited to apply. Students should have a resident GPA and an overall GPA of 3.50 or higher. Student should also have a GPA of 3.50 or higher in their Materials Science, MS&E, or BME major, and meet the Department’s “High Impact” experience requirements (described below).

Application Procedure and Requirements – Submit an application form (available in the Department office) after completing four semesters at UW-EC, but no later than the student’s graduation semester (e.g., during the Spring semester for a May graduate). A departmental faculty member familiar with the student’s work (i.e., the student’s faculty advisor, research advisor, etc.) must endorse the application. In addition to the GPA requirements listed above, the student submits evidence to the supporting faculty member that at least two High Impact experiences (of the seven) listed below have been completed; completing one of the seven experiences twice is not sufficient for Department Honors.

1. a summer research experience off campus as part of a federal program (NSF, NIST, DoD, DoE, etc.)
2. an appropriate internship related to the student’s major
3. a Study Abroad experience or Domestic Intercultural Immersion experience
4. an appropriate “professional” presentation, which can be met by either:
   a. any presentation at an off-campus conference
   b. an oral presentation at CERCA, the Provost’s Honors Symposium, the WiSys Quick Pitch, or an accepted talk at the departmental seminar series
5. a faculty/student collaborative research project (that includes a poster presentation at CERCA)
6. a publication in a peer-reviewed journal
7. other immersive experience that is approved by the Materials Science & Biomedical Engineering faculty for departmental honors

Faculty
Douglas Dunham, Chair
Liz Glogowski
Amir Javan-Khoshkhohlgh
Matt Jewell
Ying Ma
Marcus McEllistrem
Michael Walsh
Douglas Dunham, Materials Science and Engineering Center (MSEC) Director
Professional Staff, MSEC:
Laurie McEllistrem
Anthony Wagner

Majors
- Comprehensive Major: Biomedical Engineering - B.S. (http://catalog.uwec.edu/undergraduate/arts-sciences/materials-science-biomedical-engineering/biomedical-engineering-major-bs/)
- Comprehensive Major: Materials Science - B.A./B.S. (http://catalog.uwec.edu/undergraduate/arts-sciences/materials-science-engineering-comprehensive-major-ba-bs/)

Certificate

Biomedical Engineering (BME)
BME 201 Introduction to Biomedical Engineering (2 crs)
Prerequisite: MATH 114
Introduction to the field of biomedical engineering and the role of bioengineers. The class will cover a number of human diseases and discuss biomedical engineering techniques that are being developed to improve healthcare.

Lecture Hours: 2
Lab/Studio Hours: 0
BME 291 Special Topics in Biomedical Engineering (1-3 crs)
Prerequisite: CHEM 105 or CHEM 115; PHYS 231; BME 201
Consent: Instructor Consent Required
Field trips optional. A total of no more than nine credits from BME 291 and BME 491 may be applied toward major or graduation.
Lecture and possibly laboratory or field work in the study of current topics in Biomedical Engineering of special interest to students and faculty.
Repeat: Course may be repeated for a maximum of 9 credits

BME 301 3D Printing in Medicine (3 crs)
This course will introduce students to the emerging use of 3D Printing in medicine. Students will learn the process of taking medical imaging data to the production of physical anatomic models. The course will cover the basics of imaging, methods used to create 3D computer models from imaging data, the processing of imaging files with CAD software and the conversion into files that are compatible with 3D printing.
Lecture Hours: 2
Lab/Studio Hours: 2

BME 320 Clinical Problems in Biomedical Engineering (3 crs)
Prerequisite: BME 201, BIOL 221, and BIOL 314
Lectures and discussions to investigate advances in the use of engineering approaches to address key clinical problems that exist in the medical field. Engineering topics will include: bioinstrumentation, medical imaging, biomaterials, biomechanics and medical devices. This course builds on the Engineering and Biology principles introduced in BME 201.
Lecture Hours: 3
Lab/Studio Hours: 0

BME 330 Biomedical Engineering Instruments and Measurements w/lab (4 crs)
Prerequisite: BME 320; PHYS 232; MATH 312; PHYS 240
Principles and the application of instrumentation that are used for medical measurements and observing physiological variables. The class will focus on the detection of signals, data acquisition and processing, and display of signals. Topics will include: respiration, heart sounds, temperature, and blood pressure. Hands on practical experience with biomedical instrumentation will be included.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

BME 340 Biomaterials (3 crs)
Prerequisite: BME 320 or MSE 350
Introduction to the role of materials used in medicine such as polymers, metals, ceramics, hydrogels, and smart polymers. Discussions of key biological principals involved with using materials in humans will include cell adhesion, extracellular matrix, cell-biomaterial interactions, inflammation and rejection.
Lecture Hours: 3
Lab/Studio Hours: 0

BME 370 Medical Imaging (3 crs)
Prerequisite: BME 330
Introduction to the engineering, scientific principles and computation associated with medical imaging technologies including: X-ray, computed tomographic, ultrasound, magnetic resonance, and nuclear imaging. A brief overview of optical technologies and biophotonic approaches will be covered.
Lecture Hours: 3
Lab/Studio Hours: 0

BME 395 Directed Studies (1-3 crs)
Prerequisite: Minimum 2.0 GPA in Biomedical Engineering
Consent: Department Consent Required
This course is designed to allow a single student or a group of students to pursue their educational goals and interests under the direction of a faculty member.
Repeat: Course may be repeated for a maximum of 3 credits
Grading Basis: A-F Grades Only

BME 430 Cell and Tissue Engineering w/lab (4 crs)
Prerequisite: BME 320
Introduction to the principles and techniques of cell and tissue engineering. Labs will be focused on growing and manipulating human cell lines and conducting a range of cell biology assays. Experiments on creating 3D engineered scaffolds and associated assays will be conducted.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

BME 450 Medical and Implantable Devices w/lab (5 crs)
Prerequisite: BME 330; BME 340 (or concurrent)
Topics will include the theory and applications of therapeutic implantable devices such as pacemakers, defibrillators, artificial skin, and drug delivery systems. Discussion of the role of host reaction to biomaterials, inflammation, and wound healing. Biological testing of devices and prostheses; medical product development, quality assurance for medical products; FDA and ISO requirements for medical devices will also be included.
Lecture/Discussion Hours: 4
Lab/Studio Hours: 2

BME 460 Biological Systems Analysis (3 crs)
Prerequisite: MATH 312; BME 320; PHYS 240
Computational and mathematical modeling of biological processes (system dynamics and frequency-domain analysis). Topics covered will include population models, metabolic networks, biological oscillation, and dynamics of infectious diseases.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
**BME 486 BME Capstone I (2 crs)**
Prerequisite: MSE 256 or concurrent enrollment; BME 320; MSE 307; MSE 386 or departmental consent
First of a two-course capstone sequence. Hands-on, project-based experiences including engineering design, problem solving and Computer Aided Design (CAD).

Lab/Studio Hours: 0
Seminar Hours: 4

**BME 487 BME Capstone II (2 crs)**
Prerequisite: BME 486
Second of a two-course capstone sequence. Conclusion of student-designed projects accompanied by preparation of multiple technical documents.

Attributes: LE-I1 Integration
Lab/Studio Hours: 0
Seminar Hours: 4

**BME 493 Collaborative Internship (1-3 crs)**
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
This course provides students an opportunity to participate in collaborative projects that are performed on campus under the supervision of a faculty member.

Repeat: Course may be repeated for a maximum of 6 credits
Grading Basis: A-F Grades Only

**BME 494 Off-campus Biomedical Engineering Internship (1-3 crs)**
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
Off-campus internship with a regional company or other partner, including professional development training and reflection.

Repeat: Course may be repeated for a maximum of 6 credits
Grading Basis: A-F Grades Only

**BME 499 Independent Study - Seniors (1-3 crs)**
Prerequisite: Minimum senior standing
Consent: Department Consent Required
This course provides senior-level students with research opportunities in Biomedical Engineering.

Repeat: Course may be repeated for a maximum of 6 credits
Grading Basis: A-F Grades Only

**MSE 221 Living in a Materials World (3 crs)**
Prerequisite: MATH 114 or concurrent enrollment. No credit if taken after MSCI 100.
Processing and structure’s impact on materials properties and performance. Societal benefits of sustainable, biomimetic, or responsible materials selection.

Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

**MSE 256 Introduction to Computer Aided Design (1 cr)**
Prerequisite: MATH 109 or concurrent enrollment.
The course provides an introduction to 3-dimensional computer aided design and modeling.

Lecture/Discussion Hours: 0
Lab/Studio Hours: 3

**MSE 286 Engineering Sophomore Seminar (1 cr)**
Career preparation for materials science, materials science and engineering, and biomedical engineering majors. Will include seminars with external speakers and class discussions of relevant issues.

**MSCI 291 Special Topics in Materials Science (1-3 crs)**
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115; PHYS 232; MSE 221
Consent: Instructor Consent Required
Field trips optional. A total of no more than nine credits from MSCI 291 and MSCI 491 may be applied toward major or graduation.

Lecture and possibly laboratory or field work in the study of current topics in Materials Science of special interest to students and faculty.

Repeat: Course may be repeated for a maximum of 9 credits

**MSE 307 Engineering Statistics (4 crs)**
Prerequisite: MATH 114. Credit may not be earned in both MATH 345 and MSE 307.
Enrollment before or concurrent with MSE 368 recommended.
Principles of engineering experimentation and data collection, elementary probability distributions, use of confidence intervals and significance tests in engineering design and decision-making, use of statistical software, design of experiments, statistical process control

Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

**MSE 315 Materials Characterization (4 crs)**
Prerequisite: CHEM 103 or CHEM 115 and PHYS 211 or PHYS 231 or concurrent enrollment.
A survey of commonly used materials characterization methods (XPS, SEM, AFM, XRD, XRF), including their theory of operation and hands-on experience. Includes a discussion of the measurement process and instrumental analysis of samples.

Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 2
Lab/Studio Hours: 4

**Materials Science (MSCI)**

**MSE 120 Introduction to Engineering (2 crs)**
Prerequisite: MATH 109 or concurrent enrollment.
A comprehensive study of the engineering design process. Discussion of engineering disciplines with comparisons. The laboratory portion of the course includes design projects from various engineering disciplines.

Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 1
Lab/Studio Hours: 2
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisite(s)</th>
<th>Description</th>
<th>Lecture/Discussion Hours</th>
<th>Lab/Studio Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE 334</td>
<td>Soft Materials (4 crs)</td>
<td>4</td>
<td>CHEM 325 and MSE 221</td>
<td>Includes in-depth soft materials topics such as synthesis and processing, structure-property relationships, and applications of soft materials.</td>
<td>4</td>
<td>0</td>
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<tr>
<td>MSE 350</td>
<td>Thermodynamics of Materials (4 crs)</td>
<td>4</td>
<td>MSCI 100 or MSE 221 or GEOL 312; CHEM 104 or CHEM 109 or CHEM 115; MATH 215; PHYS 232 or concurrent enrollment.</td>
<td>Survey of the laws of thermodynamics and their application in Materials Science including phase equilibria. Mathematical skills relevant to engineering applications are discussed in the lab section.</td>
<td>3</td>
<td>2</td>
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<tr>
<td>MSE 357</td>
<td>Phase Transformation &amp; Kinetics (3 crs)</td>
<td>3</td>
<td>MSE 221; MATH 215; CHEM 104 or CHEM 109 or CHEM 115</td>
<td>Phase transformations are explored with emphasis on microstructure development, the impact of diffusion, and nucleation/growth mechanisms.</td>
<td>3</td>
<td>0</td>
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<tr>
<td>MSE 362</td>
<td>Microelectronic Materials Processing (2 crs)</td>
<td>2</td>
<td>MSE 350; MSE 357 or concurrent enrollment.</td>
<td>The fabrication of microelectronic devices is discussed, and the thermodynamics and kinetics that impact process design. Methods and practices are reviewed.</td>
<td>2</td>
<td>0</td>
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<tr>
<td>MSE 363</td>
<td>Microelectronic Materials Processing Lab (2 crs)</td>
<td>2</td>
<td>MSE 350 or CHEM 433 or PHYS 332.</td>
<td>The fabrication of microelectronic devices is explored. Methods and practices for photolithography, etching, and deposition are studied in a lab setting.</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>MSE 367</td>
<td>Macroprocessing of Materials (3 crs)</td>
<td>3</td>
<td>MSE 357</td>
<td>Processing approaches for major categories of bulk materials. Topics range from raw materials to forming and finishing of final products.</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>MSE 368</td>
<td>Macroprocessing Materials Lab (2 crs)</td>
<td>2</td>
<td>MSE 367 or concurrent enrollment.</td>
<td>Practical and analytical aspects of processing techniques and investigation of structure-property-processing relationships using hands-on experiences.</td>
<td>0</td>
<td>6</td>
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<tr>
<td>MSE 372</td>
<td>Transport Phenomena (3 crs)</td>
<td>3</td>
<td>MATH 312</td>
<td>Principles of momentum, heat, and mass transport. Applications of appropriate differential equations and boundary conditions to solve problems in materials processing.</td>
<td>3</td>
<td>0</td>
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<tr>
<td>MSE 374</td>
<td>Electrical, Optical and Magnetic Properties of Materials (4 crs)</td>
<td>4</td>
<td>PHYS 332 or MSE 350</td>
<td>A description of the behaviors of crystalline solids. Topics include crystallography, diffraction, and the electrical, optical and magnetic properties of materials. Semiconducting materials and devices will also be discussed.</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>MSCI 384</td>
<td>Materials Science Junior Seminar (1 cr)</td>
<td>1</td>
<td>MSE 286</td>
<td>Career preparation for Materials Science majors, including ethics and other discussions relevant to the major. Will include seminars with external speakers and class discussions of relevant issues.</td>
<td>0</td>
<td>1</td>
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<tr>
<td>MSCI 385</td>
<td>Materials Science Junior Seminar II (0.5 crs)</td>
<td>0.5</td>
<td>MSCI 384</td>
<td>The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>MSE 386</td>
<td>Engineering Junior Seminar (1 cr)</td>
<td>1</td>
<td>MSE 286 and limited to Pre-Materials Science and Engineering or Materials Science and Engineering majors or declared Biomedical Engineering majors</td>
<td>Career preparation for materials science and engineering and biomedical engineering majors, including ethics and other discussions relevant to the major. Will include seminars with external speakers and class discussions of topical issues.</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Credits: 33
MSE 387 MS&E Junior Seminar II (0.5 crs)
Prerequisite: MSE 386; Limited to Materials Science and Engineering majors
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSCI 395 Directed Studies (1-3 crs)
Prerequisite: Minimum 2.0 GPA in Materials Science or Materials Science & Engineering comprehensive majors
Consent: Department Consent Required
This course is designed to allow a single student or a group of students to pursue their educational goals and interests under the direction of a faculty member.
Repeat: Course may be repeated
Grading Basis: A-F Grades Only

MSCI 399 Independent Study - Juniors (1-3 crs)
Prerequisite: Minimum junior standing.
Consent: Department Consent Required
This course provides junior-level students with research opportunities in Materials Science or Materials Science & Engineering.
Repeat: Course may be repeated
Grading Basis: A-F Grades Only

MSE 451 Computational Materials Science (3 crs)
Prerequisite: MSE 350 or PHYS 333 or CHEM 434.
Theory and application of computational methods to model, understand and predict the behavior of materials. Labs provide hands-on experience in solving real materials problems using computational approaches.
Lecture/Discussion Hours: 2
Lab/Studio Hours: 3

MSE 475 Nanomaterials (3 crs)
Prerequisite: CHEM 104 or 109 or 115, and one of the following: MSE 350, or PHYS 333, or CHEM 434.
Quantum behavior and statistical mechanics of nanomaterials, plus modern synthesis methods, electronic and optical applications, biomaterials.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSCI 484 Materials Science Capstone I (1 cr)
Prerequisite: MSE 350; Credit may not be earned in both MSCI 480 and MSCI 484
First of a two-course capstone sequence. This course emphasizes hands-on, project-based experiences that are formulated and executed by the student.
Lab/Studio Hours: 0
Seminar Hours: 2

MSCI 485 Materials Science Capstone II (2 crs)
Prerequisite: MSCI 484; Credit may not be earned in both MSCI 485 and MSCI 481
Second of a two-semester capstone sequence. This course emphasizes writing projects based on student designed experiments.
Attributes: LE-I1 Integration
Lab/Studio Hours: 0
Seminar Hours: 4

MSE 486 MS&E Capstone I (2 crs)
Prerequisite: MSE 256 or concurrent enrollment; MSE 350; MSE 387 or departmental consent
First of a two-course capstone sequence. Hands-on, project-based experiences including engineering design, problem solving and Computer Aided Design (CAD).
Lab/Studio Hours: 0
Seminar Hours: 4

MSE 487 MS&E Capstone II (2 crs)
Prerequisite: MSE 486
Second of a two-course capstone sequence. Conclusion of student-designed projects accompanied by preparation of multiple technical documents.
Attributes: LE-I1 Integration
Lab/Studio Hours: 0
Seminar Hours: 4

MSCI 491 Special Topics in Advanced Materials Science (1-3 crs)
Prerequisite: MSCI 300. Limited to Materials Science or Materials Science & Engineering majors.
Consent: Instructor Consent Required
• Field trips optional. A total of no more than nine credits from MSCI 291 and MSCI 491 may be applied toward major or graduation.
Lecture and possibly laboratory or field work in the study of current topics of Materials Science of special interest to advanced students and faculty.
Repeat: Course may be repeated for a maximum of 9 credits

MSCI 493 Collaborative Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
This course provides students an opportunity to participate in collaborative projects that are performed on campus under the supervision of a faculty member.
Attributes: Internship
Grading Basis: A-F Grades Only
MSE 494 Off-campus Materials Science Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
Off-campus internship with a regional company or other partner, including professional development training and reflection.
Attributes: Internship
Grading Basis: A-F Grades Only

MSCI 499 Independent Study - Seniors (1-3 crs)
Prerequisite: Minimum senior standing.
Consent: Department Consent Required
This course provides senior-level students with research opportunities in Materials Science or Materials Science & Engineering.
Repeat: Course may be repeated
Grading Basis: A-F Grades Only

Materials Science and Engineering (MSE)

MSE 120 Introduction to Engineering (2 crs)
Prerequisite: MATH 109 or concurrent enrollment.
A comprehensive study of the engineering design process. Discussion of engineering disciplines with comparisons. The laboratory portion of the course includes design projects from various engineering disciplines.
Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 1
Lab/Studio Hours: 2

MSE 221 Living in a Materials World (3 crs)
Prerequisite: MATH 114 or concurrent enrollment. No credit if taken after MSCI 100.
Processing and structure's impact on materials properties and performance. Societal benefits of sustainable, biomimetic, or responsible materials selection.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 256 Introduction to Computer Aided Design (1 cr)
Prerequisite: MATH 109 or concurrent enrollment.
The course provides an introduction to 3-dimensional computer aided design and modeling.
Lecture/Discussion Hours: 0
Lab/Studio Hours: 3

MSE 286 Engineering Sophomore Seminar (1 cr)
Career preparation for materials science, materials science and engineering, and biomedical engineering majors. Will include seminars with external speakers and class discussions of relevant issues.

MSE 307 Engineering Statistics (4 crs)
Prerequisite: MATH 114. Credit may not be earned in both MATH 345 and MSE 307.
  • Enrollment before or concurrent with MSE 368 recommended.
Principles of engineering experimentation and data collection, elementary probability distributions, use of confidence intervals and significance tests in engineering design and decision-making, use of statistical software, design of experiments, statistical process control
Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

MSE 315 Materials Characterization (4 crs)
Prerequisite: CHEM 103 or CHEM 115 and PHYS 211 or PHYS 231 or concurrent enrollment.
A survey of commonly used materials characterization methods (XPS, SEM, AFM, XRD, XRF), including their theory of operation and hands-on experience. Includes a discussion of the measurement process and instrumental analysis of samples.
Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 2
Lab/Studio Hours: 4

MSE 334 Soft Materials (4 crs)
Prerequisite: CHEM 325 and MSE 221
Includes in-depth soft materials topics such as synthesis and processing, structure-property relationships, and applications of soft materials.
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

MSE 350 Thermodynamics of Materials (4 crs)
Prerequisite: MSCI 100 or MSE 221 or GEOL 312; CHEM 104 or CHEM 109 or CHEM 115; MATH 215; PHYS 232 or concurrent enrollment.
Survey of the laws of thermodynamics and their application in Materials Science including phase equilibria. Mathematical skills relevant to engineering applications are discussed in the lab section.
Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

MSE 357 Phase Transformation & Kinetics (3 crs)
Prerequisite: MSE 221; MATH 215; CHEM 104 or CHEM 109 or CHEM 115
Phase transformations are explored with emphasis on microstructure development, the impact of diffusion, and nucleation/growth mechanisms.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
MSE 362 Microelectronic Materials Processing (2 crs)
Prerequisite: MSE 350; MSE 357 or concurrent enrollment. No credit if taken after MSCI 362
• Formerly MSCI 362.
The fabrication of microelectronic devices is discussed, and the thermodynamics and kinetics that impact process design. Methods and practices are reviewed.
Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 2
Lab/Studio Hours: 0

MSE 363 Microelectronic Materials Processing Lab (2 crs)
Prerequisite: MSE 350 or CHEM 433 or PHYS 332. No credit if taken after MSCI 363
• Formerly MSCI 363.
The fabrication of microelectronic devices is explored. Methods and practices for photolithography, etching, and deposition are studied in a lab setting.
Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 0
Lab/Studio Hours: 4

MSE 367 Macroprocessing of Materials (3 crs)
Prerequisite: MSE 357
Processing approaches for major categories of bulk materials. Topics range from raw materials to forming and finishing of final products.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 368 Macroprocessing Materials Lab (2 crs)
Prerequisite: MSE 367 or concurrent enrollment.
Practical and analytical aspects of processing techniques and investigation of structure-property-processing relationships using hands-on experiences.
Lecture/Discussion Hours: 0
Lab/Studio Hours: 6

MSE 372 Transport Phenomena (3 crs)
Prerequisite: MATH 312
Principles of momentum, heat, and mass transport. Applications of appropriate differential equations and boundary conditions to solve problems in materials processing.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 374 Electrical, Optical and Magnetic Properties of Materials (4 crs)
Prerequisite: PHYS 332 or MSE 350
• Credit may not be earned in both MSE 374 and PHYS 374.
A description of the behaviors of crystalline solids. Topics include crystallography, diffraction, and the electrical, optical and magnetic properties of materials. Semiconducting materials and devices will also be discussed.
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

MSE 386 Engineering Junior Seminar (1 cr)
Prerequisite: MSE 286 and limited to Pre-Materials Science and Engineering or Materials Science and Engineering majors or declared Biomedical Engineering majors
• Must be admitted to MSE by first day of class or declared BME major.
Career preparation for materials science and engineering and biomedical engineering majors, including ethics and other discussions relevant to the major. Will include seminars with external speakers and class discussions of topical issues.
Lab/Studio Hours: 0
Seminar Hours: 1

MSE 387 MS&E Junior Seminar II (0.5 crs)
Prerequisite: MSE 386; Limited to Materials Science and Engineering majors
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSE 451 Computational Materials Science (3 crs)
Prerequisite: MSE 350 or PHYS 333 or CHEM 434
Theory and application of computational methods to model, understand and predict the behavior of materials. Labs provide hands-on experience in solving real materials problems using computational approaches.
Lecture/Discussion Hours: 2
Lab/Studio Hours: 3

MSE 475 Nanomaterials (3 crs)
Prerequisite: CHEM 104 or 109 or 115, and one of the following: MSE 350, or PHYS 333, or CHEM 434.
Quantum behavior and statistical mechanics of nanomaterials, plus modern synthesis methods, electronic and optical applications, biomaterials.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
MSE 486 MS&E Capstone I (2 crs)
Prerequisite: MSE 256 or concurrent enrollment; MSE 350; MSE 387 or departmental consent
First of a two-course capstone sequence. Hands-on, project-based experiences including engineering design, problem solving and Computer Aided Design (CAD).
Lab/Studio Hours: 0
Seminar Hours: 4

MSE 487 MS&E Capstone II (2 crs)
Prerequisite: MSE 486
Second of a two-course capstone sequence. Conclusion of student-designed projects accompanied by preparation of multiple technical documents.
Attributes: LE-I1 Integration
Lab/Studio Hours: 0
Seminar Hours: 4

MSE 493 Collaborative Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
This course provides students an opportunity to participate in collaborative projects that are performed on campus under the supervision of a faculty member.
Attributes: Internship
Grading Basis: A-F Grades Only

MSE 494 Off-campus Materials Science Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
Off-campus internship with a regional company or other partner, including professional development training and reflection.
Attributes: Internship
Grading Basis: A-F Grades Only