Materials Science and Engineering

Materials Science and Engineering
Head of Department: David G. Cahill
Department Office: 201 Materials Science and Engineering Building, 1304 West Green, Urbana
Phone: 217-333-1441
www.matse.illinois.edu

MSE 101 Materials in Today's World  credit: 3 hours.
Introduction to the field of materials science. Examination and demonstration of materials and their properties in the context of their use in everyday objects. Survey of the role materials have played and will continue to play in shaping society. Intended for non-engineering majors. Technical elective credit is not given to College of Engineering majors.

This course satisfies the General Education Criteria for a:
Nat Sci & Tech - Phys Sciences

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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>39568</td>
<td>Discussion/ Recitation</td>
<td>AD1</td>
<td>04:00 PM - 04:50 PM</td>
<td>T</td>
<td>4101 - Materials Science &amp; Eng Bld</td>
<td>Goodman, M</td>
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</tbody>
</table>

Nat Sci & Tech - Phys Sciences course.

| 39569 | Discussion/ Recitation| AD2     | 04:00 PM - 04:50 PM | R    | 4101 - Materials Science & Eng Bld | Goodman, M |

Nat Sci & Tech - Phys Sciences course.

| 30427 | Lecture               | AL1     | 03:00 PM - 03:50 PM | TR   | 135 - Mechanical Engineering Bldg | Goodman, M |

Nat Sci & Tech - Phys Sciences course.
Students should register for the lecture and one discussion session.

MSE 182 Introduction to MatSE  credit: 2 hours.
Overview of MatSE as a basis for understanding how structure, property, and processing relationships are developed and used for different types of materials. Case studies of advances in new materials and processes illustrating the role of materials in modern society. Laboratory-discussion demonstrations and experiments. Design-team analysis or synthesis of objects that use materials creatively.

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<th>Instructor</th>
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<tbody>
<tr>
<td>30429</td>
<td>Lecture-Discussion</td>
<td>A</td>
<td>12:30 PM - 01:50 PM</td>
<td>TR</td>
<td>103 - Talbot Laboratory</td>
<td>Huang, P</td>
</tr>
</tbody>
</table>

Restricted to First Time Freshman students.
Restricted to Civil Engineering or Computer Engineering or Computer Science or Electrical Engineering or Engineering Mechanics or Engineering Physics or Industrial Engineering or Materials Science & Engr or Mechanical Engineering or Chemical Engineering or Bioengineering or Aerospace Engineering or Agricultural & Biological Engr or Nuclear, Plasma, Radiolgc Engr or Engineering Undeclared or Systems Engineering and Design or Pre-Engineering major(s).
Introductory course for entering Materials Science freshmen or other College of Engineering entering freshmen who are considering a Materials Science major. Not intended for transfer students or any other upper-level undergraduates.

**MSE 199  Undergraduate Open Seminar**  credit: 1 TO 5 hours.
May be repeated to a maximum of 5 hours. May be repeated in the same term.

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<tbody>
<tr>
<td>10557</td>
<td>Independent Study</td>
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<td>ARRANGED -</td>
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</table>

Instructor Approval Required

**MSE 201  Phases and Phase Relations**  credit: 3 hours.
Understanding microstructure. Quantitative examination of phases (crystalline and non-crystalline structures) and the relationships between phases (phase diagrams). Commercial practices for producing desired microscopic phase configurations and macroscopic shapes (processing). Credit is not given for both MSE 201 and MSE 280. Prerequisite: MSE 182; credit or concurrent enrollment in CHEM 104, MATH 231 and PHYS 211.

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<tr>
<td>30431</td>
<td>Lecture</td>
<td>AL1</td>
<td>09:30 AM - 10:50 AM</td>
<td>TR</td>
<td>218 - Ceramics Building</td>
<td>Tang, S</td>
</tr>
</tbody>
</table>

**MSE 206  Mechanics for MatSE**  credit: 4 hours.
Statics, mechanics of materials, and fluid mechanics concepts pertinent to the fields of materials science and engineering: force resultants; stresses and strains produced in elastic bodies; microscopic effects of different loading states (tension, compression, torsion, and bending) on deformable bodies; beam stresses and deflections; three-dimensional stresses and strains; stress and strain-rate relationships for Newtonian and non-Newtonian fluids; conservation equations (control volume analysis) for fluid flow; Reynolds number; slow inertial and turbulent flows. Credit is not given for both MSE 206 and either TAM 251 or TAM 335. Prerequisite: MATH 225, MATH 241 and PHYS 211; credit or concurrent enrollment in CS 101 and MSE 201.

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<th>Instructor</th>
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<tr>
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<td>Discussion/Recitation</td>
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<td></td>
<td>Lecture</td>
<td>AL1</td>
<td>10:00 AM - 11:50 AM</td>
<td>MW</td>
<td>214 - Ceramics Building</td>
<td>Shang, J</td>
</tr>
</tbody>
</table>

**MSE 280  Engineering Materials**  credit: 3 hours.
Materials science and engineering of ceramics, electronic materials, metals and polymers. Bonding; crystallography; imperfections; processing and properties of semiconductors, polymers, metals, ceramics and composites; phase diagrams. Case studies. Credit is not given for both MSE 280 and any of CEE 300, ME 330, MSE 201. Prerequisite: CHEM 102 and PHYS 211.

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<td>30432</td>
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<td>A</td>
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<td>100 - Materials Science &amp; Eng Bld</td>
<td>Goodman, M</td>
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</table>
MSE 307  **Materials Laboratory I**  credit: 3 hours.
Experiments using optical and scanning electron microscopy and various thermal and thermodynamic measuring techniques.
Familiarization with laboratory test instruments. MSE 307 and MSE 308 are approved for General Education credit only as a sequence. Both courses must be completed to receive Advanced Composition credit. Prerequisite: Credit or concurrent registration in MSE 401 and either MSE 201 or MSE 280.

This course satisfies the General Education Criteria for a:
Advanced Composition

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<tr>
<td>32973</td>
<td>Laboratory</td>
<td>AB1</td>
<td>02:00 PM - 04:50 PM</td>
<td>T</td>
<td>105 - Ceramics Kiln House</td>
<td>TerBush, J</td>
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</tbody>
</table>

Advanced Composition course.
Restricted to Materials Science & Engr major(s).
Lab sections will meet in the Kiln House.

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<tbody>
<tr>
<td>32332</td>
<td>Laboratory</td>
<td>AB2</td>
<td>02:00 PM - 04:50 PM</td>
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</tr>
</tbody>
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<td>32401</td>
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<tr>
<td>51976</td>
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<td>AB4</td>
<td>02:00 PM - 04:50 PM</td>
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<tbody>
<tr>
<td>58741</td>
<td>Laboratory</td>
<td>AB5</td>
<td>02:00 PM - 04:50 PM</td>
<td>M</td>
<td>105 - Ceramics Kiln House</td>
<td>TerBush, J</td>
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</tbody>
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<tr>
<td>32409</td>
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<td>01:00 PM - 01:50 PM</td>
<td>MW</td>
<td>124 - Burrill Hall</td>
<td>TerBush, J</td>
</tr>
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</table>

Advanced Composition course.
Restricted to Materials Science & Engr major(s).
Student should register for the lecture and one laboratory.

MSE 396  **Introduction to Research**  credit: 1 TO 3 hours.
Fundamental tenets of research including an introduction to laboratory safety, constructing a hypothesis, and the design of experiments to test the hypothesis. Basics of mathematical modeling and statistical analysis of data, including the analysis of research data.
Emphasis on exposure to the basic procedures comprising engineering communication and the importance of verbal and written communication. Approved for Letter and S/U grading. May be repeated in separate terms.

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<td>63621</td>
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<td>05:00 PM - 06:30 PM</td>
<td>W</td>
<td>4101 - Materials Science &amp; Eng Bld</td>
<td>Cahill, D</td>
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</table>

Credit Hours: 3 hours
Advisor Approval Required
Open to any undergraduate student performing research for credit in the Materials Science and Engineering (MatSE) department. Approval of the research advisor is required.

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<tr>
<td>64410</td>
<td>Laboratory-Discussion</td>
<td>3</td>
<td>05:00 PM - 06:30 PM</td>
<td>W</td>
<td>4101 - Materials Science &amp; Eng Bld</td>
<td>Cahill, D</td>
</tr>
</tbody>
</table>

Advisor Approval Required
Open to students who want to repeat the class, having successfully completed the course at least once. Students in this section may choose 1 to 3 hours credit. Students will be exempted from some of the lectures. Approval of the research advisor is required.

MSE 397  **Independent Study**  credit: 1 TO 4 hours.
Individual study of any topic in materials science and engineering selected by the student and conducted under the supervision of a member of the faculty. May be repeated to a maximum of 4 hours. Prerequisite: Consent of instructor.

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<tbody>
<tr>
<td>10559</td>
<td>Independent Study</td>
<td>ARRANGED</td>
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Instructor Approval Required
Course Reference Numbers (CRN) for Independent Study for Individual Faculty are posted in 201 MSEB. DO NOT use the CRN listed above.

MSE 401  **Thermodynamics of Materials**  credit: 3 hours.
Basic thermodynamic principles including energy, entropy, and free energy; macroscopic properties of hard and soft materials systems, such as equilibrium states, phases, and phase transitions. Application of phase diagrams. Statistical interpretation of thermodynamics on the atomistic level. 3 undergraduate hours. 3 graduate hours. Credit is not given for both MSE 401 and CHEM 444 or PHYS 427. Prerequisite: MSE 201 or MSE 280; credit or concurrent registration in MATH 285.

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<tr>
<td>38343</td>
<td>Lecture</td>
<td>A</td>
<td>09:00 AM - 09:50 AM</td>
<td>MWF</td>
<td>1024 - Chemistry Annex</td>
<td>Dillon, S</td>
</tr>
</tbody>
</table>

MSE 403  **Synthesis of Materials**  credit: 3 hours.
Fundamentals of the synthesis of materials. Principles of synthesis; processes, approaches, synthetic methodology and probes; methodologies in materials synthesis; polymerization, sol-gel processes, liquid and vapor phase synthesis, materials coupling reactions, and precursor-derived, radiation-induced and asymmetric synthesis. 3 undergraduate hours. 3 graduate hours. Prerequisite: MSE 201; credit or concurrent registration in MSE 401.
### MSE 404 Laboratory Studies in Materials Science and Engineering  
Credit: 1.5 hours.

Experiments include direct hands-on investigations or are performed through computational approaches. Laboratory experiences include both fundamental studies as well as investigations on more applied topics. 1.5 undergraduate hours. 1.5 graduate hours. May be repeated if topics vary. Prerequisite: MSE 307 and MSE 308 or permission of instructor. Senior standing.

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<tr>
<td>66885</td>
<td>Laboratory</td>
<td>CP</td>
<td>02:00 PM - 04:50 PM</td>
<td>MW</td>
<td>127 - Ceramics Kiln House</td>
<td>Nagel, L</td>
</tr>
</tbody>
</table>

**Ceramic Processing**

Restricted to students in the Materials Science & Engineering department.


The objective of this course is to provide students with an understanding of ceramics properties and processing. Students will explore aspects of ceramic powders preparation, powder characterization, forming methods, thermal processing, and physical property characterization. Students will explore the interplay between crystal, electronic, chemical, and microstructural degrees of freedom in ceramics.

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<tbody>
<tr>
<td>66893</td>
<td>Laboratory</td>
<td>LD1</td>
<td>02:00 PM - 04:50 PM</td>
<td>MW</td>
<td>204 - Ceramics Kiln House</td>
<td>Shim, M</td>
</tr>
</tbody>
</table>

**Low Dimensional Electronics**

Restricted to students in the Materials Science & Engineering department.


Exploration of emerging materials of reduced dimensionality through hands-on experiments. Students learn to handle/process atomically thin materials such as graphene, fabricate field-effect transistors from these materials, and carry out various means of characterization including electrical, Raman, and optical measurements. In addition, effects of external stimuli (e.g., mechanical and chemical) on electrical characteristics are also examined.

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<tbody>
<tr>
<td>66894</td>
<td>Laboratory</td>
<td>LD2</td>
<td>02:00 PM - 04:50 PM</td>
<td>TR</td>
<td>204 - Ceramics Kiln House</td>
<td>Shim, M</td>
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</tbody>
</table>

**Computational MSE- Macroscale**

Restricted to students in the Materials Science & Engineering department.


Hands-on experience with popular macroscopic computational materials science and engineering software through project-based learning in finite element modeling (OOF2) and phase equilibria calculations (Thermo-Calc). Students will also develop proficiency in data analysis and visualization in MATLAB. The course will prioritize the physical principles underlying the software to confer an understanding of their applicability and limitations, and hands-on immersive praxis to give students the confidence and expertise to independently use these tools.
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<th>Description</th>
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</thead>
</table>
| 66895       | Laboratory | MIC      | 02:00 PM      | TR   | Schleife, A| Computational MSE- Microscale  
Restricted to students in the Materials Science & Engineering department.  
Hands-on experience with popular microscopic computational materials science and engineering software through project-based learning in electronic structure calculation (Quantum Espresso) and molecular simulation (LAMMPS). Students will also develop proficiency in the command line interface and bash shell scripting. The course will prioritize the physical principles underlying the software to confer an understanding of their applicability and limitations, and hands-on immersive praxis to give students the confidence and expertise to independently use these tools. |
| 66903       | Laboratory | NP1      | 02:00 PM      | MW   | Shim, M    | Novel Photovoltaics  
Restricted to students in the Materials Science & Engineering department.  
Students are introduced to emerging photovoltaic materials through hands-on experiments. Students fabricate and characterize solar cells made of materials such as organometal halide perovskites. Different methods to synthesize/deposit these materials and device architectures are examined. Students then critically examine advantages and challenges associated with integrating new materials into photovoltaics. |
| 66904       | Laboratory | NP2      | 02:00 PM      | TR   | Shim, M    | Novel Photovoltaics  
Restricted to students in the Materials Science & Engineering department.  
Students are introduced to emerging photovoltaic materials through hands-on experiments. Students fabricate and characterize solar cells made of materials such as organometal halide perovskites. Different methods to synthesize/deposit these materials and device architectures are examined. Students then critically examine advantages and challenges associated with integrating new materials into photovoltaics. |
| 66886       | Laboratory | PC1      | 02:00 PM      | MW   | Gabrielson, N| Polymer Characterization  
Restricted to students in the Materials Science & Engineering department.  
Subjects covered in lab include dilute solution viscometry, gel permeation chromatography, Fourier transform infrared spectroscopy, differential scanning calorimetry, melt rheology, rotational rheometry and gel electrophoresis. Students will gain proficiency in common laboratory techniques as well as experience working in chemical fume hoods and the safe handling of chemical reagents. |
| 66889       | Laboratory | PC2      | 02:00 PM      | TR   | Gabrielson, N| Polymer Characterization  
Restricted to students in the Materials Science & Engineering department.  
Subjects covered in lab include dilute solution viscometry, gel permeation chromatography, Fourier transform infrared spectroscopy, differential scanning calorimetry, melt rheology, rotational rheometry and gel electrophoresis. Students will gain proficiency in common laboratory techniques as well as experience working in chemical fume hoods and the safe handling of chemical reagents. |
| 66890       | Laboratory | PC3      | 08:00 AM      | TR   | Gabrielson, N| Polymer Characterization  
Restricted to students in the Materials Science & Engineering department.  
Subjects covered in lab include dilute solution viscometry, gel permeation chromatography, Fourier transform infrared spectroscopy, differential scanning calorimetry, melt rheology, rotational rheometry and gel electrophoresis. Students will gain proficiency in common laboratory techniques as well as experience working in chemical fume hoods and the safe handling of chemical reagents. |
Subjects covered in lab include dilute solution viscometry, gel permeation chromatography, Fourier transform infrared spectroscopy, differential scanning calorimetry, melt rheology, rotational rheometry and gel electrophoresis. Students will gain proficiency in common laboratory techniques as well as experience working in chemical fume hoods and the safe handling of chemical reagents.

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<td>66898</td>
<td>Laboratory</td>
<td>PS1</td>
<td>02:00 PM - 04:50 PM</td>
<td>MW</td>
<td>124 - Ceramics Kiln House</td>
<td>Gabrielson, N</td>
</tr>
</tbody>
</table>

Polymer Synthesis
Restricted to students in the Materials Science & Engineering department.
Subjects covered in lab include free radical polymerization of styrene, emulsion polymerization of styrene, anionic polymerization of styrene, step growth polymerization of a self-healing polymer, synthesis and fabrication of acid-detecting polymer sensors, fabrication of organic light emitting diodes and fabrication of polymer microspheres for drug delivery applications. Students will gain proficiency in common laboratory techniques as well as experience working in chemical fume hoods and the safe handling of chemical reagents.

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<tbody>
<tr>
<td>66899</td>
<td>Laboratory</td>
<td>PS2</td>
<td>02:00 PM - 04:50 PM</td>
<td>TR</td>
<td>124 - Ceramics Kiln House</td>
<td>Gabrielson, N</td>
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<tr>
<td>66900</td>
<td>Laboratory</td>
<td>PS3</td>
<td>08:00 AM - 10:50 AM</td>
<td>TR</td>
<td>124 - Ceramics Kiln House</td>
<td>Gabrielson, N</td>
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<tr>
<td>66901</td>
<td>Laboratory</td>
<td>TE1</td>
<td>02:00 PM - 04:50 PM</td>
<td>MW</td>
<td>113 - Ceramics Building</td>
<td>Zuo, J</td>
</tr>
</tbody>
</table>

Thin Film Electrical Properties
Restricted to students in the Materials Science & Engineering department.
Introduce seniors and new graduate students to the electrical properties of thin film materials and semiconductors through hands-on experiments. Covers both the principles and measurements of (a) thin-film resistance; (b) modification of electrical properties by thermal reaction; (c) thermoelectric effect; (d) carrier mobility and Hall effect.

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<th>Course Code</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
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<tbody>
<tr>
<td>66902</td>
<td>Laboratory</td>
<td>TE2</td>
<td>02:00 PM - 04:50 PM</td>
<td>TR</td>
<td>113 - Ceramics Building</td>
<td>Zuo, J</td>
</tr>
</tbody>
</table>

Thin Film Electrical Properties
Restricted to students in the Materials Science & Engineering department.
Introduce seniors and new graduate students to the electrical properties of thin film materials and semiconductors through hands-on experiments. Covers both the principles and measurements of (a) thin-film resistance; (b) modification of electrical properties by thermal reaction; (c) thermoelectric effect; (d) carrier mobility and Hall effect.
MSE 406  **Thermal-Mech Behavior of Matls**  credit: 3 hours.
Fundamentals of elastic, viscoelastic and plastic deformation of materials, elementary theory of statics and dynamics of dislocations; strengthening mechanisms; behavior of composites; fracture and fatigue behavior; fundamentals of thermal behavior: heat capacity, thermal expansion and conductivity; effects of thermal stress. 3 undergraduate hours. 3 graduate hours. Credit is not given for both MSE 406 and either ME 430 or TAM 424. Prerequisite: MSE 206; credit or concurrent registration in MSE 401.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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<tbody>
<tr>
<td>42990</td>
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<td>103 - Talbot Laboratory</td>
<td>Maass, C</td>
</tr>
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</table>

Restricted to Materials Science & Engr major(s).

| 63203| Discussion/Recitation | AD1  | 11:00 AM - 11:50 AM | F    | 305 - Materials Science & Eng Bld | Maass, C   |

Restricted to Materials Science & Engr major(s).

| 63204| Discussion/Recitation | AD2  | 12:00 PM - 12:50 PM | F    | 305 - Materials Science & Eng Bld | Maass, C   |

Restricted to Materials Science & Engr major(s).

| 63205| Discussion/Recitation | AD3  | 01:00 PM - 01:50 PM | F    | 305 - Materials Science & Eng Bld | Maass, C   |

Restricted to Materials Science & Engr major(s).

MSE 440  **Mechanical Behavior of Metals**  credit: 3 hours.
Mechanical behavior of solids: crystal plasticity, dislocations, point defects and grain boundaries, creep and fatigue behavior, and fracture. 3 undergraduate hours. 3 graduate hours. Prerequisite: MSE 406.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Time</th>
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<th>Instructor</th>
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<td>30439</td>
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<td>MWF</td>
<td>218 - Ceramics Building</td>
<td>Krogstad, J</td>
</tr>
</tbody>
</table>

MSE 443  Design of Engineering Alloys  credit: 3 hours.
Application of science and engineering principles to the design, selection, and performance of engineering alloys. Alloy classes, design, effect of alloying elements, relation to processing variables, and structure-property relationships; design project. 3 undergraduate hours. 3 graduate hours. Prerequisite: MSE 401 and MSE 402.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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<td>MWF</td>
<td>305 - Materials Science &amp; Eng Bld</td>
<td>Bellon, P</td>
</tr>
</tbody>
</table>

MSE 456 Mechanics of Composites  credit: 3 hours.
Behavior of composite materials and their use in engineering structures: behavior and properties of the constituent fibers and matrices, micromechanical predictions of composite properties, anisotropic elasticity, behavior of composite laminae, and classical lamination theory; fracture mechanisms, failure theories; behavior of composite plates and beams. Same as AE 428 and TAM 428. 3 undergraduate hours. 3 graduate hours. Prerequisite: AE 321, CEE 300, ME 330, or MSE 406.

<table>
<thead>
<tr>
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<th>Section</th>
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<td>243 - Mechanical Engineering Bldg</td>
<td>Sottos, N</td>
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</table>

MSE 457 Polymer Chemistry  credit: 3 OR 4 hours.
Methods used to make polymers including reaction mechanisms, kinetics, and analytical techniques. Emphasis on understanding how macromolecule structure, composition, and properties are controlled through a variety of synthetic approaches. Same as CHEM 480. 3 undergraduate hours. 3 or 4 graduate hours.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Section</th>
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Restricted to Graduate - Urbana-Champaign.
This section is for Graduate Students only, you may choose either 3 or 4 credit hours.

<table>
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<tr>
<td>61140</td>
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<td>MWF</td>
<td>253 - Mechanical Engineering Bldg</td>
<td>Evans, C</td>
</tr>
</tbody>
</table>
MSE 470  **Design and Use of Biomaterials**  credit: 3 hours.

Characterization and use of biomaterials in medical applications. Concepts of biocompatibility in terms of structure and properties of materials and interactions between materials and proteins, cells, and tissue. Issues related to the design of biomaterials. Design of biomaterials to meet specific medical needs. 3 undergraduate hours. 3 graduate hours. Prerequisite: Credit or concurrent registration in both MCB 252 and either CHEM 232 or MSE 403.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Section</th>
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<td>MWF</td>
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<td>Cheng, J</td>
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</tbody>
</table>

MSE 480  **Surfaces and Colloids**  credit: 3 OR 4 hours.

Chemistry and physics of surfaces and interfaces, with emphasis on behavior in liquid media. Surface composition; surface and interfacial forces; colloidal stability and flocculation; amphiphilic molecules. Same as CHEM 488. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: MSE 401.

<table>
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<tr>
<th>CRN</th>
<th>Type</th>
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<th>Days</th>
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Restricted to Graduate - Urbana-Champaign. This section is for Graduate Students only, you may choose either 3 or 4 hours.

<table>
<thead>
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</table>

Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign. This section is for Undergraduates only.

MSE 485  **Atomic Scale Simulations**  credit: 3 OR 4 hours.

Application of Monte Carlo and Molecular Dynamics techniques in primarily classical simulations to understand and predict properties of microscopic systems in materials science, physics, biology, and chemistry. Numerical algorithms, connections between simulation results and real properties of materials (structural or thermodynamic), and statistical and systematic error estimation using real simulation programs. Simulation project comprised of scientific research, algorithm development, and presentation. Same as CSE 485 and PHYS 466. 3 undergraduate hours. 4 graduate hours. Prerequisite: MSE 401; one of C, C++, or Fortran programming experience.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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</table>

Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign. This section is for Undergraduate Students only.
MSE 489  **Matl Select for Sustainability**  credit: 3 OR 4 hours.
Quantitative methods to optimize the selection of materials including traditional (minimize mass or volume, maximize performance) and sustainability (minimize energy consumption and CO2 emission during synthesis, maximize recyclability) goals. Tradeoff methods to optimize both via engineering design and materials selection for product lifetime, economic outlay and return, time dynamics and materials consumption, recycling, and disposal. Application of commercial software to optimize selections. For engineering and science majors only. 3 undergraduate hours. 4 graduate hours.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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Restricted to Graduate - Urbana-Champaign. This section is for Graduate Students only. You may choose either 3 or 4 credit hours.

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<td>Abelson, J</td>
</tr>
</tbody>
</table>

Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign. This section is for Undergraduate Students only.

MSE 492  **Lab Safety Fundamentals**  credit: 1 hours.
Key aspects of laboratory setups, operating procedures, and emergency preparedness measures necessary for the experimentalist. Same as CHEM 494. 1 undergraduate hour. 1 graduate hour. Approved for S/U grading only.

<table>
<thead>
<tr>
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</table>

Meets 10-Sep-18 - 24-Sep-18.
Restricted to Engineering or Graduate College. Restricted to students with Junior, Senior, or Graduate class standing. This course is for engineering students only. All other students register under CHEM 494. This class meets only five times each semester. PLEASE NOTE - THE FIRST CLASS WILL MEET ON MONDAY, SEPTEMBER 10, 2018.

MSE 497  **Independent Study**  credit: 1 TO 4 hours.
Individual study of any topic in materials science and engineering under the supervision of a member of the faculty. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated to a maximum of 4 hours. Prerequisite: Consent of instructor.

<table>
<thead>
<tr>
<th>CRN</th>
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</tbody>
</table>

Instructor Approval Required
MSE 499  **Senior Thesis**  credit: 1 TO 5 hours.
Individual research in an area of materials science and engineering under the supervision of members of the staff. 1 to 5 undergraduate hours. No graduate credit. May be repeated to a maximum of 6 hours. Prerequisite: Grade point average of 3.0 and consent of instructor.

<table>
<thead>
<tr>
<th>CRN</th>
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</table>

Instructor Approval Required

Individual Advisor course reference numbers (CRN) are posted in 201 MSEB. DO NOT use the number listed above.

MSE 500  **Statistical Thermody of Matls**  credit: 4 hours.
Atomistic concepts of statistical thermodynamics and their relationship to classical phenomenological thermodynamics. Application of the methods of statistical thermodynamics and statistical mechanics to describe the structure, phase behavior, and properties of both hard and soft materials. Prerequisite: MSE 401.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<tr>
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<td></td>
<td>Lecture</td>
<td>A</td>
<td>09:00 AM - 09:50 AM</td>
<td>MWF</td>
<td>218 - Ceramics Building</td>
<td>Schweizer, K</td>
</tr>
</tbody>
</table>

Restricted to Graduate - Urbana-Champaign.

MSE 529  **Hard Materials Seminar**  credit: 0 TO 1 hours.
Seminar on current research in science and engineering of hard materials; presentations by visiting lecturers, staff, and students. Approved for S/U grading only. May be repeated.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Time</th>
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<th>Instructor</th>
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<tr>
<td>30465</td>
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</table>

MSE 559  **Soft Materials Seminar**  credit: 0 TO 1 hours.
Seminar on current research in the science and engineering of soft materials; presentations by visiting lecturers, staff, and students. Approved for S/U grading only. May be repeated.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<td>04:00 PM - 05:20 PM</td>
<td>T</td>
<td>119 - Materials Science &amp; Eng Bld</td>
<td>Evans, C</td>
</tr>
</tbody>
</table>
MSE 584  **Point and Line Defects**  credit: 4 hours.
Formation and interactions of point and line defects in solids including metals, semiconductors, dielectrics, and ionic conductors. Theoretical treatment of thermal equilibrium and non-equilibrium conditions. Application to impurity diffusion, ion irradiation, dislocation generation and motion, ionic conductivity, and deep level electronic defects. Prerequisite: MSE 401 or MSE 501; PHYS 460 or PHYS 560.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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MSE 590  **Research Seminars**  credit: 0 TO 1 hours.
Discussions and lectures on current research under the direction of individual staff members. Approved for S/U grading only. May be repeated. Prerequisite: Consent of instructor.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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<tr>
<td>10568</td>
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</tr>
</tbody>
</table>

Instructor Approval Required
Individual Advisor course reference numbers (CRN) are posted in 201 MSEB. DO NOT use the number listed above.

MSE 595  **Materials Colloquium**  credit: 0 TO 1 hours.
Presentation of (i) cutting-edge materials research by visiting lectures from academia as well as national and industrial research laboratories and (ii) some of the current research conducted in the Department. Approved for S/U grading only. May be repeated.

<table>
<thead>
<tr>
<th>CRN</th>
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MSE 597  **Independent Study**  credit: 1 TO 4 hours.
Individual study of any topic in materials science and engineering under the supervision of a member of the faculty. May be repeated to a maximum of 4 hours. Prerequisite: Consent of instructor.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Location</th>
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</table>

Instructor Approval Required
Course Reference Numbers (CRN) for Independent Study for Individual Faculty are posted in 201 MSEB. DO NOT use the CRN listed above.

MSE 599  **Thesis Research**  credit: 0 TO 16 hours.
Approved for S/U grading only. May be repeated.
<table>
<thead>
<tr>
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Instructor Approval Required
Course Reference Numbers (CRN) for thesis research for Individual Faculty are posted in 201 MSEB. DO NOT use the CRN shown above.