EMAT 351  
Fundamentals of Materials  
Lecture: T & Th 12:30–1:45 pm

Instructor: Sudhakar Vadiraja, Ph.D., P.E.  
Office Hours: ELC 218, x4267  
M thru F: 11:00-12:00 noon  
or by appointment

Catalogue Description:
The course starts with a review of the structure and bonding within materials. The various mechanical tests 
that characterize material properties are then presented. The lectures then focus on the strength and the 
unique ductility of metals and how these properties can be influenced by processing. The use of phase 
diagrams and phase transformations in materials processing are described. Structure-property-processing-
performance relationships are examined in engineering alloys, ceramic materials, polymers and composites.

Credits: 3.0 Credit Hours (Lectures)

Designation: Required course (Metallurgical & Materials Engineering, General Engineering – Welding 
Option)

Prerequisites: EMAT 251/EGEN 213 or permission of the instructor.

Co-requisite: EMAT 353 Microstructural Interpretation or permission of the instructor.


Additional References:
Cengage learning, 2014.

Relationship of Course to Metallurgical and Materials Engineering Program Outcomes:
This course develops fundamental themes in materials science and engineering which are continued in the 
spring semester and in senior year.

Objectives: The objective of this course is to provide the student with:
1) a sound understanding of the structure, processing, properties and performance of materials,
2) a qualitative and quantitative understanding of the relationships between them, and
3) knowledge of the limits of these factors in materials science and engineering.

Outcomes: Graduates of the course will or will be able to:
1) understand process fundamentals for engineering materials,
2) define and understand performance measures in materials testing,
3) understand concepts of plastic deformation, strain hardening, recovery, recrystallization, and 
grain growth and how these relate to performance and microstructure,
4) Phase diagram’s application to material’s performance and microstructure,
5) understand powder metallurgy processing concepts/principles,
6) identify factors important to nucleation and growth in phase transformations,
7) identify the important processes and microstructures that influence the performance of metals, 
ceramics, and polymers.
8) Fulfill ABET outcomes 1 & 9 (consult the Course Catalog and Department Guidelines)
### Course Plan

<table>
<thead>
<tr>
<th>Course Plan</th>
<th>Forecast lectures</th>
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<tbody>
<tr>
<td>1. Review of structure-property relationships (Ch 1-6)</td>
<td>1</td>
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<tr>
<td>2. Process Fundamentals for Materials (Ch 7)</td>
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<td>3. Cold working: Recovery, Recrystallization &amp; Grain growth (Ch 7)</td>
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<td>4. Performance – Fracture, Fracture toughness &amp; Impact energy (Ch 8)</td>
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<td>5. Performance – Fatigue &amp; Creep (Ch 8)</td>
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<td>6. Processing &amp; Applications of Metal Alloys (Ch 11)</td>
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<td>7. Processing of Metal Powders (<em>Powder Metallurgy</em>)</td>
<td>3</td>
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<tr>
<td>8. Structure, Processing &amp; Applications of Ceramics (Ch 12 &amp; 13)</td>
<td>3</td>
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<tr>
<td>9. Structure, Processing &amp; Applications of Polymers (Ch 14 &amp; 15)</td>
<td>3</td>
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<td>10. Structure, Processing &amp; Applications of Composites (Ch 16)</td>
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<tr>
<td><strong>Tests</strong></td>
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<td><strong>Total</strong></td>
<td><strong>26</strong></td>
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### Assessment:

- HW: 10%
- Tests (2): 50%
- Term Paper (*Presentation only*): 10%
- Finals: 30%
- Total: 100%

*Excessive absence will result in lowering of the final grade.*

A = (92-100), A− = (90-91.9), B+ = (88-89.9), B = (82-87.9), B− = (80-81.9), C+ = (78-79.9), C = (72-77.9), C− = (70-71.9), D+ = (68-69.9), D = (62-67.9), D− = (60-61.9), F = (0-59.9)

### Academic Integrity:

Students enrolled in the Metallurgical and Materials Engineering courses are expected to maintain an integrity standard that is consistent with the applicable fundamental canons of the NSPE Code of Ethics for Engineers. Specifically, students are expected to conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession. Academic dishonesty or cheating will not be tolerated.

Acts of academic dishonesty include but are not limited to:

- Aiding another student in an act of academic dishonesty
- Copying from another student’s paper while taking a quiz or examination
- Plagiarism
- Unauthorized signatures (use of another person’s signature without authorization)
- Using unlawful aids (books, notes, cell phones or other electronic devices, etc.) to pass an examination

If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, the student will be dropped from the course with an “F” grade. In compliance with Montana Tech policy, cases of academic dishonesty will be reported to the Office of the Vice Chancellor for Academic Affairs. Consult the Montana Tech catalog for more information about the school’s Academic Dishonesty policy.

With one exception, the Department policy is that electronic devices are not to be activated or evident during lectures and examinations. This restriction includes but is not limited to programmable calculators, cell phones, Ipods, or entertainment devices. The exception is that students are permitted to use a
nonprogrammable calculator during some lectures, quizzes, and exams; however, calculators of any type will not necessarily be permitted for all quizzes and exams. Students that possess unapproved calculators or other electronic devices during a quiz or exam are subject to dismissal from the classroom. Unless used as part of an approved disability accommodation (see below), it is not permissible to record (video or audio) class lectures. Penalties for disregarding the electronic device policy will be imposed at the instructor’s discretion.

**Attendance:**
Students are expected to attend at least 90% of the lectures. *Role may be taken randomly. Students who arrive after role is taken or depart prior to dismissal are considered absent.* Students must arrange to submit assignments, if any, in advance of field trips, athletics, or other school-sanctioned events that force them to miss class. Following an absence, students must arrange to obtain class notes from another student. The instructor’s lecture notes are not available to students.

It is your responsibility to sit for the examinations at the scheduled dates and times. *As a general rule, make-up quiz/test/examinations are not given for unexcused absences.* Exceptions are decided on a case-by-case basis for unavoidable absences resulting from sudden illness or other extreme emergencies.

**Requirement:**
1. Attend at least 90% of the classes.
2. Attend all tests/exams and all home work assignments MUST be completed.
3. *Talking with other students during lecturing in class is prohibited and is considered disruptive behavior.***
4. *DO NOT use EAR phones and Cell-phones during class-room lectures.*

**Contribution to Professional Component:**
- Engineering Topics- Yes
- Engineering Design- Yes (Introductory)
- Computer Usage- Yes
- Ethics- No
- Statistics- No
- Safety- No

**ABET outcomes covered: 1 & 9**
1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
9) To integrate the understanding of the scientific and engineering principles underlying the four major elements of the field: structure, properties, processing, and performance related to material systems appropriate to the field

*Prepared by: Sudhakar Vadiraja, Ph.D., P.E.*