MONTANA TECH
Department of Metallurgical and Materials Engineering

EMAT 351 Instructor: **Sudhakar Vadiraja, Ph.D., P.E.**
Fundamentals of Materials Office Hours: ELC 218, ×4267

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: 2.0 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.

Required: William .D. Callister, Jr., and David G. Rethwisch: *Materials Science and Engineering: An Introduction*, **10th** Edition, John Wiley & Sons (**2018**). ISBN : 9781119405399 ISBN-13: 9781119321590.

Additional References:
- D.R. Askeland & W. J. Wright, *Essentials of Materials Science and Engineering*, *3rd* Edition, Cengage learning, 2014.
- Charles M. Gilmore, *Materials Science and Engineering Properties*, Cengage learning, 2015.

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 metallugy 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)

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	Tentative Course Plan	Forecast lectures
1	Process Fundamentals for Materials (Ch 7)	3
2	Cold working: Recovery, Recrystallization & Grain growth (Ch 7)	3
3	Performance – Fracture, Fracture toughness & Impact energy (Ch 8)…***Test 1***	3
4	Performance – Fatigue & Creep (Ch 8)	3
5	Processing & Applications of Metal Alloys (Ch 11)…***Test 2***	2
6	Processing of Metal Powders (*Powder Metallurgy*)	3
7	Structure, Processing & Applications of Ceramics (Ch 12 & 13)	2
8	Structure, Processing & Applications of Polymers (Ch 14 &15)	3
9	Structure, Processing & Applications of Composites (Ch 16)…***Finals***	2
	Tests	**2**
	Term paper presentations	**4**
	Total	**30**

Assessment:

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

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

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.
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.

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

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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**.