

MSE 1011: Structure and Properties Laboratory **Syllabus for 2024 Spring**

Instructor: Dr. Yingjie Wu (Office: SCUPI North 405; Email: yingjie.wu@scupi.cn)

Lecture: 2 Credits, Thursday, 8:15 am – 9:00 am, SCUPI North 208

Lab: Thursday, 9:10 am – 11:00 am, SCUPI North 302 MSE Lab

Office Hours: Thursday, 1:50 pm – 4:25 pm, SCUPI North 405

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QQ Group: 812528993

Prerequisites: ENGR 0022, MSE 1010

Course Description:

This course provides a hands-on exploration of some of the concepts introduced in course ENGR 0022 Materials Structure and Properties. This will include microstructural evolutions during cold working and heat treatment with the observation of optical microscopy and scanning electron microscopy, phase changes in binary phase diagram, mechanical property testing using digital image correlation technologies. Also, Results obtained will be related to the theoretical knowledge and metallurgical mechanisms discussed in ENGR 0022.

Course Objectives:

The goals of this course are 1) to provide exposure to and familiarity with experimental techniques and data collection in materials science and engineering, 2) to develop techniques and approaches for data analysis – and insight what has been measured and why it matters, 3) to gain practice and mastery of scientific presentation in the form of written lab reports, and 4) to familiarize with advanced materials characterization methods for metallographic samples.

Applicable ABET Outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to function on multi-disciplinary teams
3. An ability to identify, formulate, and solve engineering problems
4. An understanding of professional and ethical responsibility
5. An ability to communicate effectively
6. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Logistics:

Course meeting: Thursday, 8:15 to 11:00 am

- i) Lectures will be held in 4-201.
- ii) Labs will be either in MSE lab 3-118 or TBA.
- iii) You must keep this timeslot open, although we will not always fill it.

Prerequisites:

You must have taken:

- i) ENGR 0022 – Materials Structure and Properties
- i) MSE 1010 - Experimental Methods in Materials Science and Engineering

You should have taken:

- i) MEMS 0040 – Manufacturing Processes and Analysis (but not strictly required)

It is assumed that the student has a basic working knowledge of:

- i) Phase diagrams: reading and understanding the diagrams, identifying phases and eutectics, solubility, and relative composition of phases.
- ii) Basic kinetics: equilibrium cooling (i.e., through a phase boundary) and time-temperature-transformation diagrams.

Required Resources:

Required textbook:

There is no required textbook in this course.

Useful supporting materials:

1. Callister, W.D., and D.G. Rethwisch, *Materials Science and Engineering: An introduction*, 9th ed., Hoboken, NJ: Wiley, 2014. Print.
2. Vander Voort, G.F., *Metallography: Principles and Practice*, Materials Park, OH: ASM International, 1999. Print.
3. Dieter, G.E., *Mechanical Metallurgy*, 3rd ed., New York: McGraw-Hill, 1986. Print.
4. Périé, J.-N., and J.-C. Passieux, *Advances in Digital Image Correlation (DIC)*, MDPI, 2020. Online.
5. Reimer, L., *Scanning Electron Microscopy: Physics of Image Formation and Microanalysis*, 2nd ed., Berlin: Springer, 1998. Print.

Lab Safety Requirements:

A mandatory **CHEMICAL HYGIENE TRAINING** guide will be uploaded to BlackBoard, please read it and complete the quiz. The students who **CANNOT** pass the quiz will not be allowed in lab.

Please always observe correct laboratory safety practices and instructions. A few highlights:

- i) Wear eye protection and gloves when required.

- ii) Do not come to the laboratory in shorts or open-toed sandals.
- iii) Secure long hair when working with machinery with moving parts.
- iv) Do not disturb laboratory equipment that is not used directly in the laboratory.

Grading Policies:

Requirements	Corresponding Percentages
Lab Reports (5)	75%
Lecture & Lab attendance	25%

Grading Scale:

100% ≥ A ≥ 90%; 90% > A- ≥ 85%; 85% > B+ ≥ 80%; 80% > B ≥ 76%; 76% > B- ≥ 73%; 73% > C+ ≥ 70%; 70% > C ≥ 66%; 66% > C- ≥ 63%; 63% > D ≥ 60%; 60% > F.

Lab Reports:

There will be about five lab reports that will be submitted to Blackboard either as Word document or as pdf **before the start of the class (8:15 am) on the due day**. If you are unable to attend a class, you may attach a note to your lab report and submit it in advance. **If the lab report is submitted late, you would lose 10% per day. You may receive no credit if the lab report is not submitted within a week from the due day.**

Each lab report will be checked for plagiarism by using SafeAssign after your submission to BlackBoard. **You may receive no credit, if the similarity score of your lab report is higher than 15%.**

The detailed format and contents of lab reports will be discussed in lectures.

Attendance:

Participation through presence but also reading the lab guides and getting prepared, answering questions, asking questions, getting hands-on in the lab, and contributing to activities is very important to improve active learning for each student. Therefore, your participation will be graded during each lecture starting with the second week.

Course Content (tentative):

WEEK	DAY	DATE	TOPIC	ROOM	DUE
1	Thu	2/29/24	LECTURE: Introduction, review syllabus, lab safety training	SCUPI North 208	
2	Thu	3/7/24	LECTURE: Review on Fe-C binary phase, TTT and CCT diagrams	SCUPI North 208	
			LAB 1: Effects of microalloying elements on TTT and CCT diagrams determined by JMatPro Software	SCUPI North 302	
3	Thu	3/14/24	LECTURE: Diffusional and diffusionless phase transformation	SCUPI North 208	<i>Lab 1 report - DUE BY 8:15 am</i>
			LAB 2: Effects of transformation temperatures and cooling rates on austenite decomposition products	SCUPI North 302	
4	Thu	3/21/24	LAB 2: Effects of transformation temperatures and cooling rates on austenite decomposition products	SCUPI North 302	
5	Thu	3/28/24	LECTURE: Cold working and annealing	SCUPI North 208	<i>Lab 2 report - DUE BY 8:15 am</i>
			LAB 3: Effects of annealing temperatures on final microstructures of cold rolled materials	SCUPI North 302	
6	Thu	4/4/24	LAB 3: Effects of annealing temperatures on final microstructures of cold rolled materials	SCUPI North 302	
7	Thu	4/11/24	LECTURE: Electron backscattered diffraction (EBSD)	SCUPI North 208	<i>Lab 3 report - DUE BY 8:15 am</i>
			LAB 4: EBSD analysis of metallic materials	SCUPI North 302	
8	Thu	4/18/24	LAB 4: EBSD analysis of metallic materials	SCUPI North 302	
9	Thu	4/25/24	LECTURE: Brittle and ductile fracture	SCUPI North 208	<i>Lab 4 report - DUE BY 8:15 am</i>
			LAB 5: Metallurgical determination of brittle and ductile materials	SCUPI North 302	
10	Thu	5/2/24	LAB 5: Metallurgical determination of brittle and ductile materials	SCUPI North 302	
11	Thu	5/9/24	LECTURE: Polymer	SCUPI North 208	<i>Lab 5 report - DUE BY 8:15 am</i>
			LAB 6: Mechanical behavior of polymer	SCUPI North 302	
12	Thu	5/16/24	LAB 6: Mechanical behavior of polymer	SCUPI North 302	
13	Thu	5/23/24	LECTURE: Nanoindentation	SCUPI North 208	<i>Lab 6 report - DUE BY 8:15 am</i>
			LAB 7: Nanohardness determination of metallic materials	SCUPI North 302	
14	Thu	5/30/24	LECTURE: Fundamentals of additive manufacturing	SCUPI North 208	<i>Lab 7 report - DUE BY 8:15 am</i>
			LAB 8: Additive manufacturing of polymer	SCUPI North 302	
15	Thu	6/6/24	LAB 8: Additive manufacturing of polymer	SCUPI North 302	
16	Thu	6/13/24	LAB 8: Additive manufacturing of polymer	SCUPI North 302	
17	Thu	6/20/24	LECTURE: Wrap up	SCUPI North 208	<i>Lab 8 report - DUE BY 8:15 am</i>