MSE 1010: Experimental Methods in Materials Science and Engineering
Syllabus for 2024 Fall

Instructor: Dr. Yingjie Wu (Office: SCUPI Room N405; Email: yingjie.wu@scupi.cn)

Lecture: 3 Credits, Thursday, 8:15 am – 11:00 am, SCUPI Room N213
Lab: Thursday, 8:15 am – 11:00 am, SCUPI Room N302
Office Hours: Friday, 1:50 pm – 4:25 pm, SCUPI Room N405
TA: Feiyang Liu (Email: 2021141520087@stu.scu.edu.cn)
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QQ Group: 517511518
Prerequisites: ENGR 0022

Course Description:

This course provides an in-depth exploration of experimental techniques used in materials science and engineering. Students will learn the fundamentals of designing and conducting experiments to characterize and analyze the properties of various materials. The course covers a wide range of techniques, from basic material characterization methods to advanced imaging and spectroscopy techniques. Emphasis will be placed on hands-on laboratory experience, data analysis, and interpretation of results.

Course Objectives:

The goals of this course are 1) to understand the principles behind various experimental methods used in materials science and engineering, 2) to select appropriate experimental techniques for specific materials characterization tasks, 3) to design and conduct experiments, including sample preparation, instrumentation setup, and data acquisition, 4) to analyze experimental data using statistical methods and relevant software tools, 5) to interpret experimental results to draw meaningful conclusions about material properties, 6) to communicate experimental procedures, results, and conclusions effectively through written reports and presentations and 7) to develop critical thinking skills in evaluating the limitations and potential sources of error in experimental work.

Applicable ABET Outcomes:

- (a) An ability to apply knowledge of mathematics, science, and engineering.
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
- (c) An ability to design a system, component, or process to meet desired needs.
- (e) An ability to identify, formulate, and solve engineering problems.
- (k) 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

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:

1. Suryanarayana, C. ***Experimental Techniques in Materials and Mechanics***, Boca Raton, FL: CRC Press, 2011. Print.

Useful supporting materials:

1. Vander Voort, G.F. ***Metallography: Principles and Practice***, Materials Park, OH: ASM International, 1999. Print.
1. Fischer-Cripps, A. C, ***Nanoindentation***, 3rd ed., New York, NY: Springer New York, 2011. Print.
2. Périé, J.-N. and J.-C. Passieux, ***Advances in Digital Image Correlation (DIC)***, MDPI, 2020. Online.
3. 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 (6)	75%
Lecture & Lab Participation	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.

Participation:
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	9/5/24	**LECTURE:** Introduction, review syllabus, basis of metallography	N213	
2	Thu	9/12/24	**LAB 1:** Metallogrphic sample preparation	N302	
3	Thu	9/19/24	**LAB 1:** Metallogrphic sample preparation	N302	
4	Thu	9/26/24	**LECTURE:** Technical writing, optical microscopy, hardness measurement	N213	*Lab 1 Report - DUE by 8:15 am*
5	Thu	10/3/24	**LAB 2:** Quantitative stereology	N302	
6	Thu	10/10/24	**LAB 2:** Quantitative stereology	N302	
7	Thu	10/17/24	**LAB 3:** Microhardness measurements and analysis	N302	*Lab 2 Report - DUE by 8:15 am*
8	Thu	10/24/24	**LAB 3:** Microhardness measurements and analysis	N302	
9	Thu	10/31/24	**LECTURE:** Tensile testing, scanning electron microscopy	N213	
10	Thu	11/7/24	**LAB 4:** Tensile testing and determination of engineering stress-strain curve	N302	*Lab 3 Report - DUE by 8:15 am*
11	Thu	11/14/24	**LAB 4:** Tensile testing and determination of engineering stress-strain curve	N302	
12	Thu	11/21/24	**LAB 5:** Microstructure observation and surface chemistry analysis via analytical EDX-SEM	N302	
13	Thu	11/28/24	**LAB 5:** Microstructure observation and surface chemistry analysis via analytical EDX-SEM	N302	
14	Thu	12/5/24	**LECTURE:** 3D optical profiler	N213	*Lab 4 Report - DUE by 8:15 am*
15	Thu	12/12/24	**LAB 6:** Surface roughness determination via 3D optical profiler	N302	
16	Thu	12/19/24	**LAB 6:** Surface roughness determination via 3D optical profiler	N302	
17	Thu	12/26/24	**LECTURE:** Wrap up	N213	*Lab 5&6 Report - DUE by 8:15 am*