MEMS 1010: EXPERIMENTAL METHODS IN MATERIALS SCIENCE AND ENGINEERING
Course Syllabus

Fall 2022

Catalog Description

This laboratory will give the student practical experience of the experimental methods used in modern materials science and engineering (MSE). The first set of experiments will introduce the common methods for analyzing material structure including: optical microscopy, X-ray diffraction, and scanning electron microscopy (SEM). The second part of the course will concentrate on methods used to measure material properties such as the tensile test, hardness test, impact testing as well as electrical and magnetic property measurement methods. Although those techniques are reviewed from the field of materials science and engineering (MSE), they are applicable to many other areas, such as IE, ME, Bio, pharmaceutical, and criminal labs. Technical writing, data collection and processing, and intellectual property will also be emphasized in the course. Technical writing, data collection and processing, and intellectual property will also be emphasized. 3 credits.

Schedule: Lecture Room3-104, Laboratory Zone 3-118 (Flexible time)
Thursday 8:15-11:00am

Instructor: Prof. Charles Hua charleshua2017@scupi.cn
Mobile and WeChat ID 17760422493

Teaching Assistants
Yujie Li, 15856397878, liyujie@stu.scu.edu.cn
Yiwen Shi, 15928541063 shiyiwen@stu.scu.edu.cn

Lab Manager
Yuna Tu, yuna.tu@scupi.cn, WeChat ID 15828581086


Charles Hua


Yujie Li


Yiwen Shi


Yuna Tu

When emailing the instructors, include "MSE1010" in the subject field of your message. Use your university email account (student_ID_number@stu.scu.edu.cn); mail from other accounts might be stopped by the SCU spam filter.

Textbook and Reference Book

No textbook at this moment.

Reference book: *Handbook of Analytical Methods for Materials*, Materials Engineering and Evaluation Inc., 2001, MEE HAMM (mee-inc.com)

We will cover some basic metallographic methods and some advanced analytical techniques in materials science. Reading assignments will be posted to the class blackboard website. Read the assigned chapter BEFORE class.

- You *must* have taken:
  - Materials Structure and Properties (Or equivalent, or consent of instructor)

- You *should* have taken:
  - MEMS 040 – Materials and Manufacturing (But not strictly required)
  - ENGR0028 – Materials Science and Engineering – An Introduction
- It is assumed that the student has a basic working knowledge of:
  - **Phase diagrams:** reading and understanding the diagrams, identifying phases and eutectics, solubility and relative composition of phases
  - **Basic kinetics:** equilibrium cooling (i.e. through a phase boundary) and time-temperature-transformation diagrams
  - **Microstructure:** Phases, eutectics, lamellae, connection to phase diagrams and kinetics

If these terms are fuzzy to you, review your course notes. If they are totally unfamiliar, beware…

Software

We will use some software for quantitative image analysis.
Digital Micrograph download link：http://tem.zcjce.com/download, code：GMS@simr
EBSD for Oxford Instrument https://mtex-toolbox.github.io/Documentation.html

You will also use Microsoft Word or the like to write up your assignments. Learn how to use the equation editor, grammar and spell check and how to format documents.

Web Site

This course uses the Blackboard system; the web site is

pibb.scu.edu.cn

In the content area you will find the course syllabus, homework assignments, and other materials. All assignments will be uploaded through the Blackboard system. Please check the class page frequently.

Class Format: Hands-on Lab and Lecture

For laboratory work and report, you will be divided into groups of 4 people. Each person in the group will take turn to be the leader and have a chance to be responsible for report writing.

The lecture is taught using a combined lecture, reading, review and discussion format. The class begins with two session lecture to review material in the literature and introduce new concepts. In the third session, the lecturer may ask questions to as many students as possible and encouraging critical reading of published papers in related field.

It is imperative that you come to class prepared. This will generally involve reading all posted literature and viewing tutorial videos, or hand in your pre-lab paperwork.

Submitting Lab Reports and Homework

Lab work is done by group and the report should include names of group member, their roles in the lab work and writing. The filename of the lab report should be in the format Group1-MSE1010-Lab1Name. Both word and pdf formats are required.

You may work with other people on homework, but all writeups must be individual efforts. The homework filename should be in the format StuID1234-MSE1010-HW1.

All work should be submitted electronically through the Blackboard system. Late homework will not be accepted.

Unless specifically requested, emailed homework will not be accepted.

If you are sick or have a compelling emergency that prevents you from turning in the homework on time, contact the student advisor (administration office), our TA, and WeChat or email Prof. Charles Hua.

If you believe an error has been made in the grading of lab work or assignment, bring it to the attention of your TA or instructor within ONE WEEK of its return.

Grading

There is NO exam for this course.
Your grade will be based on homework (20%), lab reports and presentation (60%) and class participation (20%).

Office Hours

If you do not understand something, and talking to your classmates doesn't help, then you should be seeking help from the instructor or teaching assistant.

Office hours are times we have specifically set aside to be available to students. During office hours, you can come to our office; you do not need an appointment. We are also available at other times; please email to schedule a time.

Current office (Zone 3-332B) hours will be Thursday 2-5 pm.

Course Goals

1. Provide exposure to and familiarity with experimental techniques and data collection in materials science and engineering
2. Develop techniques and approaches for data analysis – and insight what has been measured and why it matters
3. Gain practice and mastery of scientific writing in the form of lab reports

Approximate Schedule

Week	Topic	Read/Due
1	Introductions, Syllabus Basics of metallography	Homework: HRTEM Data
2	Safety training Digital Micrograph, EBSD	Optical and electron microscopy,
3	LAB 1: Metallographic sample prep -	Pre-lab for lab 1
4	Technical writing 1. Literature, citations, plagiarism; 2. Writing lab reports; 3. Feedback from Lab 1	Guidance for lab reports; Sample lab reports
5	Quantitative stereology	Lab 1 Report - DUE BY 1pm
6	LAB 2: Quantitative stereology – Optical	Pre-Lab, EBSD
7-8	Weldment HAZ, micro-tensile, photo-elastic	Lab 2 Report - DUE BY 1pm
9-10	LAB 3: Vickers Hardness	Pre-lab for lab 3
11	Weld microstructures, Clad Nanoindentation	Read: Weld references Lab 3 Report - DUE BY 1pm
12	LAB 4: Tensile Test, DIC, Impact Test	Pre-lab for lab 4
13	LAB 5: Heat Treatment	Pre-lab, Turbine blade and SEM references
14	EDS - Materials properties analysis	Read: EDS references Lab 4/5 Report - DUE BY 1pm
15	Lab 6 SEM and HRTEM	Pre-lab for lab 6
16	Residual Stress, Shear Strength	Lab 6 Report - DUE BY 1pm
17	Presentation	