SCUPI
Sichuan University - Pittsburgh Institute

MEMS 1010: EXPERIMENTAL METHODS IN MATERIALS SCIENCE AND ENGINEERING Fall 2020
Course Syllabus

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, archaeological, and criminal labs. Technical writing, data collection and processing, team work, and intellectual property will also be emphasized in the course. 3 credits.

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)
- 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…

Schedule: Lecture Room 3-102, Lab 3-118

Thursday 8:15 – 11:05 am (or by appointment)

Instructor: Prof. Charles Hua charleshua@scu.edu.cn
4-216 17760422493 (mobile/WeChat)

Teaching Assistant

Tesla Yin 2017141522025@stu.scu.edu.cn

Lab Manager/Engineer

Liu Liu WeChat: liuliu7294

When emailing the instruction team, include "MEMS1010" 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 formal textbook.

Reference books:

1. Handbook of Analytical Methods for Materials, Materials Evaluation and Engineering, Inc., Plymouth, MN, 2001.
2. Experiments in Materials Science and Engineering, T. A. Khraishi and M. S. Al-Haik, Cognella Academic Publishing, San Diego, CA. ©2011 by University Readers, Inc. ISBN: 978-1-60927-868-7, ISBN-10: 1609278682.

Software

We will use some software for quantitative image analysis.

You will also use Microsoft Word to write up your assignments. Learn how to use the equation editor in Word and how to format documents.

Web Site

This course uses the Blackboard system; the web site is

https://learn.scupi.cn/

(Note: the **https** is important, otherwise it may not load.) 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

EXPERIMENTAL METHODS IN MATERIALS SCIENCE AND ENGINEERING is taught using a combined lecture, reading, review, and discussion format. The class begins with two session lectures 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. You are welcome to give feedback and suggestions.

For laboratory work and report, you will be divided into groups of 5 people. Each person in the group will take turn to be the leader for one of the 5 labs.

It is imperative that you come to class prepared. This will generally involve reading all posted literature and viewing tutorial videos.

Submitting Lab Reports and Homework

Your group leader is to submit the lab report on time. The lab report cover page should list group number, each group member's name, ID, his or her major role in the work and writing. The filename of the report should be in the format MSE1010-Lab3-Group5 and the group leader should submit the report on everyone's behalf.

You should submit pre-lab paper work to TA in person, when you enter the lab. You may work with other people on homework, but all writeups must be individual efforts. The filename of the report should be in the format MSE1010-HW1-ID1234.

All reports and homework 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) and WeChat or email Prof. Charles Hua.

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

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 hours will be Thursday 2-5 pm (zone 4 -216).

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

Grading

There is NO exam for this course. Your grade will be based on homework, pre-lab, lab cleaning, and assignment (20%), lab reports (5) with an oral presentation (60%), and class participation (20%).

For example, 10 points are assigned for final presentation and the work is divided into 5 parts. Each group member will be mainly responsible for one part (role). He or she will get his or her role points (individual gain) first. Then the group average (G) is calculated. His or her individual total includes these two parts. You get perfect score only when your group is perfect, as shown in the following table.

Individual Role or Work Part	Individual Gain, Max 5	Group Ave. Max 5	Individual Total, Max 10
Introduction	A	G=(A+B+C+D+E)/5	A+G
Exp. Steps	B		B+G
Results	C		C+G
Discussion	D		D+G
Sum + Writing	E		E+G

Appendix - Approximate Schedule

Week	Topic	Read/Due
1	Introductions, review syllabus Basics Optical microscopy	Safety training Sample prep
3	LAB 1: Metallographic sample prep - Section, Mount, Polish	Pre-lab for lab 1
4	Technical writing 1: Literature, citations, plagiarism 2: Writing lab reports	General guidance for lab reports; Team work, Two sample lab reports
6	LECTURE: Quantitative stereology	Lab 1 Report – DUE Read: Quantitative stereology
7	LAB 2: Stereology – Optical	Pre-lab for lab 2
8	Hardness measurements	
9	Weldment HAZ, XRD	Lab 2 Report - DUE
10	LAB 3: Weld, Vickers Hardness	Pre-lab for lab 3
11	Weld microstructures Nanoindentation	Read: Weld references Lab 3 Report - DUE
12	LAB 4: Tensile Test	Pre-lab for lab 4
13	Turbine blades and superalloys SEM - Electron imaging and interactions	Read: Turbine blade Read: SEM references
14	EDS – Visiting Analytical Center	Read: EDS references Lab 4 Report - DUE
15	LAB 5: Heat Treatment Design	Pre-lab for lab 5
16	Residual Stress, Shear Strength	Lab 5 Report Due
17	Oral Presentation	
18	Final Grade	