**MEMS 1010: EXPERIMENTAL METHODS IN Course Syllabus**

**MATERIALS SCIENCE AND ENGINEERING Fall 2019**

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# 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 Room 4-204，Lab Room 3-118 and others

Wednesdays 8:15-11:00am

# Instructor Prof. Charles Hua, Office 4-226 [charleshua@scu.edu.cn](mailto:charleshua@scu.edu.cn)

17760422493 (Wechat)

**Teaching Assistant** Huiqin Wang, [1757599429@qq.com](mailto:1757599429@qq.com)

Criss Zeng may also help with the lab.

**Lab Manager/Engineer** Liu Liu, [liuliu2019@scu.edu.cn](mailto:liuliu2019@scu.edu.cn)

When emailing the instructor or TA, include “2019F-MSE\_1010” in the subject field of your message. Use your university email account (ID\_number@stu.scu.edu.cn); mail from other accounts might be stopped by the SCU spam filter.

# Textbook

*None at this moment*

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…

# Software

We will use a 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.) There you will find the course syllabus, homework assignments, and other materials. Current announcements and assignments will be posted on the home page. 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 in the afternoon 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.

For laboratory work and report, you will be divided into groups of 4 or 5 people. Each person in the group will take turn to be the leader for one of the 5 labs. That means everyone will have a chance to be the leader and be responsible for report writing.

**It is imperative that you come to class prepared.** This will generally involve reading all posted literature and viewing tutorial videos. This is a three credit hour class, which means you should expect to devote at least 9 to 12 hours of effort outside the scheduled class time every week.

# Homework Assignments

Homework problems will be assigned about every three weeks and posted on Blackboard. These are to be completed and turned in by **Monday 1:30 PM** the following week. You may work with other people on homework, but all write-ups must be individual efforts. Homework will be graded on a 0-100 point scale.

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

Unless specifically requested, emailed homework will not be accepted.

Please adhere to these homework guidelines:

* Your assignment must be typeset using Word and submitted electronically through Blackboard. Handwritten assignments will not be accepted.
* Put your name, ID number (last four digits), and class section at the top of the first page, e.g., “MyName2016 2018F-MSE\_1010”
* List the names of other people you've worked with on the assignment or report.

All of the homework scores will be used in your grade computation. Unless otherwise indicated, you can work with your fellow classmates in the class, but you must submit a distinct and independent write-up to receive credit.

If you’re sick, or have a compelling emergency that prevents you from turning in the homework on time, 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.

# Grading

The will be one final exam for this course.

Your grade will be based on the pre-lab homework (10%), lab attendance and participation (20%), lab reports and presentation (10%x5 =50%) and final exam (20%).

# Office Hours

If you don’t 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 don’t need an appointment. We are also available at other times; please email to schedule a time.

Current office hours will be Monday and Tuesday afternoon, 1-6pm, zone 4 -226.

# Course Goals

# Provide exposure to and familiarity with experimental techniques and data collection in materials science and engineering

# Develop techniques and approaches for data analysis – and insight what has been measured and why it matters

# Gain practice and mastery of scientific writing in the form of lab reports

# Approximate Schedule

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| **Week** | **Date** | **Topic** | **Read/Due** |
| 1 | Sept. 3 | Introductions, review syllabus  Basics of metallography | Sample prep (GAL) |
| 2 | Sept. 10 | Safety training  Optical microscopy | Optical microscopy |
| 3 | Sept. 17 | LAB 1: Metallographic sample preparation - Section, Mount, Polish, etch, Observation | Assignment 1: Pre-lab for lab 1 |
| 4 | Sept. 24 | General guidance for lab reports; sample reports |
| 6 | Oct. 8 | Technical writing 1: Literature, citations, plagiarism  2: Writing lab reports  3: Feedback from Lab 1  LECTURE: Quantitative stereology | Lab 1 Report - DUE BY 1pm  Read: Quantitative stereology |
| 7 | Oct. 15 | LAB 2: Quantitative stereology -Grain Size, Volume Fraction | Assignment 2: Pre-lab for lab 2 |
| 8 | Oct. 22 | Lecturer:Tensile Curve  (E, G, ν, τ) |  |
| 9 | Oct. 29 | LAB 3: DIC and Tensile Test | Lab 2 Report - DUE BY 1pm |
| 10 | Nov. 5 | Assignment 3: Pre-lab for lab 3 |
| 11 | Nov. 12 | Lecturer: Weld and ERW simulation; Nanoindentation | Read: Weld references  Lab 3 Report - DUE BY 1pm |
| 12 | Nov. 19 | LAB 4: Vickers Hardness, Weld microstructure | Assignment 4: Pre-lab for lab 4 |
| 13 | Nov. 26 | Read: SEM references |
| 14 | Dec. 3 | Turbine blades and superalloys  SEM-EDS: Electron imaging and sample interactions | Read: EDS references  Lab 4 Report - DUE BY 1pm |
| 15 | Dec. 10 | LAB 5: Turbine blade or Anode - SEM | Assignment 5: Pre-lab for lab 5 |
| 16 | Dec. 17 | Read: Material Processing |
| 17 | Dec. 24 | Residual Stress, Shear Strength and More Discussion | Lab 5 Report due |
| 18 | Jan. 7 | Presentation, Review |  |
| 19 | Jan. 14 | Final Exam |  |