

MSE 450 / 510

Introduction to Materials Characterization

Spring 2019

Lectures	Mon Wed 10:45 am – 12:00 pm BDH 201	Grading	MSE 450	MSE 510
Instructor	Prof. Qing Hua Wang	Homework	35%	30%
Office hours	Tues 10 – 11 am Or by appointment	Midterms	45%	45%
		Project	20%	25%
		Surveys (Bonus)	1.5%	1.5%

Course Description

This course will cover microscopy and spectroscopy methods used to characterize the structure and composition of materials. The underlying principles, advantages and disadvantages, and applications of each technique will be studied. The characterization techniques to be covered include optical and electron microscopy, scanning probe microscopy, x-ray and electron diffraction and spectroscopy, vibrational spectroscopy, and ion beam spectroscopy.

Learning Objectives

After taking this course, students will be able to: describe the operating principles of various characterization techniques; choose the appropriate characterization tool to obtain particular desired information about materials; interpret and analyze data from different characterization methods to determine materials structure and properties; and read and assess research literature related to and making use of materials characterization techniques.

Textbook and Resources

Yang Leng, [Materials Characterization: Introduction to Microscopic and Spectroscopic Methods](#), 2nd edition (Optional)
Additional readings, handouts, and resources will be provided throughout the course either in class or on Blackboard.

Grading Details

1. Undergraduate (MSE 450) and graduate (MSE 510) student grading

The grading components will be the same for undergraduate and graduate students, but weighted differently. The graduate students will also be graded to a more advanced standard for the final project.

2. Homework Assignments (5 assignments: 7% each for MSE 450, 6% each for MSE 510)

Homework assignments will have a combination of quantitative problem solving and qualitative questions and are due on paper in class at the start of lecture at 10:45 am. Solutions will be posted to Canvas after all assignments are handed in.

3. Midterms (3 midterms: 15% each)

Midterms will be held during class periods, with a review session in class before each test. They will be closed book and closed notes, but a reference sheet of equations and data will be provided, calculators will be allowed, and a 1-page cheat sheet will be allowed. More details will be announced later in the semester. Questions will be both quantitative and qualitative.

4. Final Project (20% for MSE 450, 25% for MSE 510)

The final project will be an in-class presentation in groups of three. MSE 510 students will be expected to incorporate a greater research-related component and will be graded to a more advanced standard. The topic will be your choice of: (A) describe a characterization technique that is not covered in lectures and discuss its operating principles, sample preparation and requirements, data and information produced, and how it is used for characterization, or (B) describe how the structure, composition, and properties of a particular material or materials system is characterized using different techniques, or (C) a topic of your choice subject to instructor approval. Additional details for the project will be announced later in the semester. Peer evaluations will also be a part of the project grade.

5. Late Submissions

Late assignments will be subjected to a 20% penalty per day (24 hrs), up to 3 days, after which they will not be accepted.

6. Requests for Regrading

Homework assignments and midterms can be re-graded by request, but the entire work will be subject to review, not just the particular question in dispute. Errors in adding up or recording points can be fixed immediately.

7. (Bonus) Surveys (4 of 5 surveys, 0.375% each, 1.5% maximum bonus)

Surveys will be held after each midterm and lab tour to gauge their effectiveness and to help you reflect on your experiences of them. They will be counted for completion for bonus points, but your answers will be anonymous.

8. Final Grades

The final letter grades will be assigned according to the following general scale. There will also be +/- grades, and the cut-offs between them are subject to change. You can download a spreadsheet on Canvas to estimate your grade.

A-/A/A+: 90-100 B-/B/B+: 80-89 C-/C/C+: 70-79 D-/D/D+: 60-69 F: 0-59

Class Policies

1. Communications

Canvas will be used to post announcements, handouts, lectures slides, homework, post-midterm and post-lab-tour surveys, and grades. You are encouraged to come to office hours to ask questions and receive help. Questions can be posted on the **Piazza** discussion site linked to this course, including clarifications for lectures, homework, course logistics, etc., and students can also answer each other's questions. If you need to email me, please write "MSE 450" or "MSE 510" in the subject heading on emails to make sure they are seen.

2. Classroom Behavior

Cell phones and pagers (must be/or state alternative rule) turned off during class to avoid causing distractions. The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

Please do not eat or drink anything that is disruptive to the class. Laptops and tablets can be used for taking notes. If you need to arrive late or leave early, please do so quietly without disrupting the class. Please treat all members of the class including instructor, grader, and students with respect and courtesy.

3. Academic Integrity

All students in this class are subject to ASU's Academic Integrity Policy (available at <http://provost.asu.edu/academicintegrity>) and should acquaint themselves with its content and requirements, including a strict prohibition against plagiarism. All violations will be reported to the Dean's office, who maintain records of all offenses. Students are expected to abide by the FSE Honor Code (<http://engineering.asu.edu/integrity/>). This policy applies to all homework assignments, midterms, and project. Any violations such as plagiarism, cheating, misrepresentation of work, etc., will be reported and will also result in a zero score for the assignment, and may result in a failing grade for the course.

4. Disability Accommodations

Suitable accommodations will be made for students having disabilities and students should notify the instructor as early as possible if they will require them. Such students must be registered with the Disability Resource Center (<https://eoss.asu.edu/drc>) and provide documentation to that effect.

5. Absence and Make-Up Policies

Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on [ACD 304-04](#), "Accommodation for Religious Practices" and [ACD 304-02](#), "Missed Classes Due to University-Sanctioned Activities."

That is, if you need to reschedule a midterm or presentation due to these reasons or due to personal emergencies, please contact me as soon as possible. Make-up midterms and presentations will not generally be given for any other reasons.

6. Sexual Discrimination

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available if you wish discuss any concerns confidentially and privately.

7. Syllabus and Schedule Changes

The syllabus and schedule of lecture topics may change slightly during the semester. The updates will be posted on Blackboard and announced in class. The key dates (midterms, homework deadlines, project deadlines, lab tours) will stay the same, but lecture topics may be shifted depending on the classroom pace.

8. Clicker questions

Interactive quizzes in the form of clicker questions will be held at the end of most lectures using the **Kahoot** website, which can be accessed using any phone, tablet, laptop, etc., so you do *not* need to buy a clicker device.

Course Schedule

Date	Lec	Topics	Suggested Readings	Assignments
1/7/19	M	1	Introduction: syllabus; overview of course topics	Handouts
1/9/19	W	2	Background on materials 1: bonding and structure	Handouts (HW 1 assigned)
1/14/19	M	3	Background on materials 2: defects and properties	Handouts
1/16/19	W	4	Optical microscopy	Ch. 1 HW 1 due
1/21/19	M	<i>No class - Martin Luther King, Jr. Day</i>		
1/23/19	W	5	X-ray diffraction	(HW 2 assigned)
1/28/19	M		X-ray diffraction 2	Ch. 2; Handouts
1/30/19	W	6	Electron microscopy 1: TEM	Ch. 3 HW 2 due
2/4/19	M	7	Review for Midterm 1; finish up any unfinished topics	
2/6/19	W	MIDTERM 1		
2/11/19	M	8	Midterm 1 solutions; Project description	(Project assigned)
2/13/19	W	LAB TOUR 1: TEM, SEM, FIB, TEM samples		
2/18/19	M	9	Electron microscopy 2: SEM	Ch. 4 (HW 3 assigned)
2/20/19	W	10	X-ray spectroscopy: WDS, EDS, XRF Fundamentals of surfaces and vacuum technologies	Ch. 6; Handouts Project signups due
2/25/19	M	11	Scanning probe microscopy 1: AFM and variations	Ch. 5; Handouts HW 3 due
2/27/19	W	12	Scanning probe microscopy 2: STM and STS	Ch. 5; Handouts (HW4 assigned)
3/4/19	M	<i>No class - Spring Break</i>		
3/6/19	W	<i>No class - Spring Break</i>		
3/11/19	M	13	Review for Midterm 2; finish up any unfinished topics	HW 4 due
3/13/19	W	MIDTERM 2		
3/18/19	M	14	Midterm 2 solutions; Background on electronic structure	Handouts
3/20/19	W	15	Electron spectroscopy: AES, XPS	Ch. 7 Project outline due
3/25/19	M	16	Ion beam spectroscopy 1: SIMS	Ch. 8 (HW 5 assigned)
3/27/19	W	17	Ion beam spectroscopy 2: RBS; Light-matter interactions	Handouts
4/1/19	M	18	Vibrational/optical spectroscopy: FTIR, Raman, UV-vis, fluorescence	Ch. 9
4/3/19	W	LAB TOUR 2: OP, EPMA, AFM, Raman/FTIR		
4/8/19	M	19	Review for Midterm 3	HW 5 due
4/10/19	W	MIDTERM 3		
4/15/19	M	PRESENTATIONS		
4/17/19	W	PRESENTATIONS		
4/22/19	M	PRESENTATIONS		
4/24/19	W	PRESENTATIONS		