

MSE 523

Structural and Mechanical Properties of Materials

Fall 2016

Lectures	Tues Thurs 1:30 pm – 2:45 pm	Grading	
Instructor	Prof. Qing Hua Wang Office hours: Wed 10:30 am – 12 pm Or by appointment	Homework	20%
		Midterms (3 x 20%)	60%
		Project	15%
		Reflections	5%

Course description

This course aims to link the structure of materials (including crystal structure and defect structure) with their properties. Students will learn basic concepts in symmetry, crystal structure, diffraction, crystal imperfections, tensors, tensor properties of materials, and mechanical behaviors such as elasticity, fracture, and creep.

Learning objectives

After taking this course, students will be able to: describe the classification of crystal structures by their symmetry; relate materials properties to crystals by their symmetry and tensor descriptions; relate crystal structures to diffraction and microscopy data; understand types of structural defects and their effects on mechanical properties; interpret and analyze structure and mechanical property measurements; and read and assess research literature related to and making use of materials structures and properties.

Textbooks and resources

Textbooks are optional, but suggested as useful resources. Additional readings, handouts, and resources will be provided throughout the course either in class or on Blackboard

[D&M] Marc De Graef and Michael E. McHenry, Structure of Materials, 2nd edition

[Nye] J.F. Nye, Physical Properties of Crystals

[M&C] M. Meyers and K. Chawla, Mechanical Behavior of Materials, 2nd edition

Grading details

1. Homework (6 assignments, drop lowest score, 5 x 4% each)

Homework assignments will have a combination of quantitative problem solving and qualitative questions and are due in class at the start of lecture at 1:30 pm. Solutions will be posted to Blackboard after all assignments are handed in.

2. Midterms (3 x 20% each)

Midterms will be held during class periods, with a review session in class before each midterm, except for the final one, which will be during the course's exam period. They will be closed book and closed notes, but a reference sheet of equations and data will be provided, and non-programmable calculators will be allowed. More details will be announced later in the semester. Questions will be both quantitative and qualitative.

3. Final project (15%)

The final project will be a choice of in-class presentation or written paper on a topic of your choice relating to some element of the course topics. The general format is a mini literature review of your topic. You will need to first pick either paper or presentation and select a preferred presentation date. Then you will submit a project outline with topic description and list of references, which will be graded. The grading will also include peer review of presentations. Additional details for the project will be announced later in the semester.

4. Reflections (5%, completion only)

Reflections are designed to help you guide your studying, link this course to your other classroom and research work, and to help improve the course delivery. All reflections submissions will only be counted for completion. The primary reflections will be "muddiest points", where you will write down the topics from lectures that were the least clear or need more explanation, and submit them anonymously on Blackboard. Selected muddiest points will be answered in more detail in class or in explanations posted online the following week.

5. Late submissions

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

6. 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 different +/- grades may change.

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

Class policies

1. Communications

Announcements, handouts, lectures slides, homework, etc., will be posted on the Blackboard site for this course. You are encouraged to come to office hours to ask questions and receive help. Please write "MSE 523" the subject heading on emails to make sure they are seen.

2. Classroom behavior

Please do not eat or drink anything that is disruptive to the class. Please silence all electronic devices (phone, tablet, laptop) and do not make phone calls or send texts during 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 must follow the ASU Student Academic Integrity Policy, which applies to all homework assignments, midterms, and project. Any violations such as plagiarism, cheating, misrepresentation of work, etc., may result in a zero score for the assignment, may result in a failing grade for the course, and will be reported to the graduate program chair(s), school director(s), academic advisor(s), and/or dean of academic and student affairs. Please see details here: <https://provost.asu.edu/academicintegrity>, <https://catalog.asu.edu/policies/engineering>

4. 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.

5. Special arrangements

Arrangements for additional time or resources for students with disabilities can be made by contacting me and by registering with the ASU Disability Resource Center (<https://eoss.asu.edu/drc>). If you need to reschedule a midterm or presentation due to emergencies or ASU excused absences such as religious holidays or university-sanctioned activities, please contact me as soon as possible in advance (see policies: [ACD 304-02](#) and [ACD 304-04](#)). Make-up quizzes and presentations will not generally be given for any other reasons.

7. Syllabus and course plan changes

The instructor will make every effort to maintain consistent dates for topics, due dates, etc., as listed below, but reserves the right to make reasonable amendments and updates to the syllabus and course plans as needed. All changes to the syllabus and schedule will be announced in class and via Blackboard / emails.

Course Schedule (tentative)

Date	Lec	Topics	Suggested readings	Assignments	
8/18/16	Th	1	Syllabus; Context and motivation of course; intro to structure and properties	D&M CH. 1; M&C Ch. 1	
8/23/16	T	2	Crystals: definition, Bravais lattices, Miller indices	D&M Ch. 3, 4, 5; M&C Ch. 1	(HW 1 assigned)
8/25/16	Th	3	Diffraction and reciprocal space	D&M Ch. 11, 12, 14	
8/30/16	T	4	Symmetry operations	D&M Ch. 8	HW 1 due
9/1/16	Th	5	Point groups	D&M Ch. 8, 9	(HW 2 assigned)
9/6/16	T	6	Plane groups, space groups, crystallography tables	D&M Ch. 6, 10	
9/8/16	Th	Review for Midterm 1		HW 2 due	
9/13/16	T	MIDTERM 1			
9/15/16	Th	7	Discuss Midterm 1; Discuss project	M&C Ch. 2	(Project assigned)
9/20/16	T	6	Plane groups, space groups, crystallography tables	D&M Ch. 6, 10	(HW 3 assigned)
9/22/16	Th	8	Introduction to stress and strain, tensors, and symmetry	M&C Ch. 2; Nye Ch. 1, 2	
9/27/16	T	9	Stress and strain tensors	Nye Ch. 5, 6	HW 3 due
9/29/16	Th	10	Conductivity, polarization, magnetic susceptibility tensors	Nye Ch. 3, 4, 9, 11	Project sign-up due
10/4/16	T	11	Piezoelectricity and elasticity tensors	Nye Ch. 7, 8	(HW 4 assigned)
10/6/16	Th	12	Plasticity and yield	M&C Ch. 3	
10/11/16	T	<i>Fall Break - class cancelled</i>			
10/13/16	Th	Review for Midterm 2		HW 4 due	
10/18/16	T	MIDTERM 2			
10/20/16	Th	13	Discuss Midterm 2; work on and get feedback on outlines		
10/25/16	T	14	Point and line defects	M&C Ch. 4	Project outline due
10/27/16	Th	15	Interfacial and volume defects	M&C Ch. 5	(HW 5 assigned)
11/1/16	T	16	Deformation, slip, strengthening mechanisms	M&C Ch. 6, 10	
11/3/16	Th	17	Fracture	M&C Ch. 7, 8, 9	HW 5 due
11/8/16	T	18	Creep	M&C Ch. 13	
11/10/16	Th	19	Fatigue	M&C Ch. 14	(HW 6 assigned)
11/15/16	T	20	Finish up any topics that are left		
11/17/16	Th	PRESENTATIONS			
11/22/16	T	PRESENTATIONS			HW 6 due
11/24/16	Th	<i>Thanksgiving - class cancelled</i>			
11/29/16	T	21	Structures and properties of special materials (nanomaterials, polymers, biomaterials, etc.)	Papers due	
12/1/16	Th	Review for Midterm 3			
12/8/16	Th	MIDTERM 3: Dec. 8, 12:10 - 2:00 PM			