MSE 523
Structural and Mechanical Properties of Materials
Fall 2015

Instructor
Prof. Qing Hua Wang
Office hours:
    Wed. 10:30 AM – 12 PM, or by appointment

Lectures
Tuesdays and Thursdays
6:00 PM – 7:15 PM

Lectures
Tuesdays and Thursdays
6:00 PM – 7:15 PM

Grading
20%   Homework
20%   Midterm 1
20%   Midterm 2
30%   Final exam
10%   Project

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.

Textbooks

[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 = 20% total)**
    Homework assignments are due in class at the start of lecture. Please staple all sheets together. You can work together with classmates to discuss solutions, but you must write up your own solutions, and write the names of your collaborators on your submission. Solutions will be posted to Blackboard after all assignments are handed in.

2. **Midterms (20% each) and final exam (30%)**
    The midterms and exam will require solving problems using pencil and paper. They will be closed book, closed notes, no calculators. All equations and charts needed to solve the problems will be provided. There will be a review session before each exam. Solutions will be discussed during the following class. The midterms will be held during regular class times and last 1 hr 15 min. The final exam will be on **Thursday, December 10, 4:50 - 6:40 PM**, or 1 hr 50 min.

3. **Project (outline 3%, final report 7%)**
    The project will be a written report in the form of a mini literature review on a topic related to the class content and feature analysis of recently published research papers. You must work independently. The grade is divided into 3% for initial topic selection, references, and outline, and 7% for the final paper. Additional details about the project will be announced later in the semester.

4. **Late submissions**
    Late assignments (homework and project) will be subjected to a 10% penalty per day, up to 50%, after which they will not be accepted.

Class policies

1. **Communications**
    Announcements, handouts, lectures, etc., will be posted on the **Blackboard site** for this course. Announcements may also be given at the start of lectures. You are encouraged

to come to office hours to ask questions and receive help. If you would like to email me, please be sure to write "MSE 523" at the start of the email subject heading.

2. **Lecture notes**

Lectures notes and/or slides will be posted online on Blackboard so you can download them ahead of class and use them to take additional notes. You are welcome to use a laptop or tablet to take notes and follow along on the electronic lecture notes.

3. **Classroom behavior**

Please do not eat or drink anything disruptive to the class (loud sounds, strong smells, etc.). Please silence your phone and do not make phone calls or send texts. 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, TA, and students with respect and courtesy.

4. **Academic integrity**

All students must follow the ASU Student Academic Integrity Policy, which applies to all homework assignments, midterms, final exam, and project. Any violations of the policy resulting in academic dishonesty such as plagiarism, cheating, misrepresentation of work, etc., may result in a zero score for the assignment or exam, 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.
More information and detailed policies:
https://provost.asu.edu/academicintegrity
https://catalog.asu.edu/policies/engineering
https://graduate.asu.edu/policies-procedures

5. **Requests for re-grading**

Homework assignments and midterms can be re-graded by request, but the entire homework or midterm will be subject to review, not just the particular question in dispute. Errors in adding up points or entering scores on Blackboard can be pointed out and fixed immediately.

6. **Special arrangements**

Arrangements or accommodations for additional time or resources for students with disabilities can be made via registration with the ASU Disability Resource Center (https://eoss.asu.edu/drc). If you need to reschedule a midterm due to emergencies or ASU excused absences such as religious observance or university-sanctioned activities, please contact me as soon as possible (see policies: ACD 304-02 and ACD 304-04).

Course Plan and Important Dates (Tentative)

Date			Lectures	Suggested readings	Evaluations
8/20/15	Th	1	Syllabus; introduction to structure and properties; examples and applications	D&M Ch. 1; M&C Ch. 1	
8/25/15	T	2	Definition of crystals, Bravais lattices, crystal systems, Miller indices	D&M Ch. 3, 4, 5; M&C Ch. 1	(HW 1 assigned)
8/27/15	Th	3	Symmetry operations I	D&M Ch. 8	
9/1/15	T	4	Symmetry operations II; Point groups	D&M Ch. 8, 9	**HW 1 due**
9/3/15	Th	5	Plane groups and space groups, international tables	D&M Ch. 6, 10	(HW 2 assigned)
9/8/15	T	6	Reciprocal space and diffraction	D&M Ch. 11, 12, 14	
9/10/15	Th	7	Symmetry in nanomaterials, biological materials, quasicrystals, etc.	D&M Ch. 15, 16, 24; M&C Ch. 1	**HW 2 due**
9/15/15	T		Midterm 1 review and Q&A		
9/17/15	Th		**MIDTERM 1**		**Midterm 1**
9/22/15	T	8	Discuss Midterm 1; Introduction to stress and strain	M&C Ch. 2	
9/24/15	Th	9	Introduction to tensors and symmetry	M&C Ch. 2; Nye Ch. 1, 2	
9/29/15	T	10	Stress and strain tensors	Nye Ch. 5, 6	(HW 3 assigned)
10/1/15	Th	11	Conductivity and magnetic susceptibility tensors	Nye Ch. 3, 4, 9, 11	(Project assigned)
10/6/15	T	12	Piezoelectricity and elasticity tensors	Nye Ch. 7, 8	**HW 3 due**
10/8/15	Th	13	Elasticity tensors cont'd	Nye Ch. 8; M&C Ch. 2	(HW 4 assigned)
10/13/15	T		Fall Break - class cancelled		
10/15/15	Th	14	Introduction to plasticity, yield conditions	M&C Ch. 3	**HW 4 due**
10/20/15	T		Midterm 2 review and Q&A		
10/22/15	Th		**MIDTERM 2**		**Midterm 2**
10/27/15	T		Discuss Midterm 2		
10/29/15	Th	15	Imperfections: point and line defects	M&C Ch. 4	
11/3/15	T		Work on project in class, discuss topic and paper selections		(HW 5 assigned)
11/5/15	Th	16	Imperfections: interfacial and volume defects	M&C Ch. 5	**Project outline due**
11/10/15	T	17	Deformation, slip, strengthening mechanisms	M&C Ch. 6, 10	**HW 5 due**
11/12/15	Th	18	Fracture	M&C Ch. 7, 8, 9	(HW 6 assigned)
11/17/15	T	19	Creep	M&C Ch. 13	
11/19/15	Th	20	Fatigue	M&C Ch. 14	**HW 6 due**
11/24/15	T	21	Mechanical properties in special materials	M&C Ch. 12, 15	
11/26/15	Th		Thanksgiving Day - class cancelled		
12/1/15	T		Topic TBA; in-class practice problems		**Project due**
12/3/15	Th		Final exam review and Q&A **(Last day of class)**		
12/10/15	Th		**Final exam: Thursday, Dec 10, 4:50 - 6:40 PM**		**Final exam**