ME 083 Fall 2008

Structure and Properties of Solids

Course Objectives, Grading Policy, and Course Syllabus [v2.0]

Course Schedule

Monday-Wednesday-Friday, 10.20 AM – 11.10 AM
Room: 125 Hudson
Lab (ME83-01L): Wednesday 3.05PM - 5.30 PM in 115A Hudson
Lab (ME83-02L): Friday 3.05PM - 5.30 PM in 115A Hudson

Instructor

Prof. Stefano Curtarolo, 233 Hudson Hall, Phone: 660-5506
e-mail: me83@materials.pratt.duke.edu
(please write [ME83] in the subject line, all other emails will be junked)

Course assistants

Teaching/laboratory: Kristine Obusek, CIEMAS 3304C, 660-5372, kro3@duke.edu
Teaching/laboratory: Angus Hucknall, TBA TBA angus.hucknall@gmail.com
Laboratory Manager: Milan Simonovic, Hudson 150A, 660-5161, ms237@duke.edu
Laboratory Manager: Patrick McGuire, Hudson 152, 660-5261, patrick.mcguire@duke.edu
Grader: TBA, tba@duke.edu

Office Hours

Curtarolo: Monday 11.10-12.30 and by appointment
Kristine Obusek (Laboratory): Monday 11.30-13.00 (or by appointment)
Angus Hucknall: (Laboratory): TBA (or by appointment)
Milan Simonovic: (Laboratory): Monday-Friday, 9.00-17.00
Patrick Mc Guire: (Laboratory): Monday-Friday, 9.00-17.00
GRADER (Homeworks/Solutions): TBA (contact for location)

Web-Site

http://materials.pratt.duke.edu/ME83/

Text Book

J. Shaffer, *et al.*,
The Science and Design of Engineering Materials (second edition)
ISBN: 0-256-24766-8, McGraw Hill, (1999)

Homeworks

Homeworks are handed out every TBA and are due the following TBA,
at the beginning of the class.

Course Description

Introduction to the structure and properties of solid materials, emphasizing the relationships between the structure of a solid and its properties. Atomic and molecular origins of electrical, mechanical, and chemical behavior are treated in some detail for metals, alloys, polymers, ceramics, glasses, and composite materials. Lectures are accompanied by laboratory work. Prerequisites: Chemistry 11L and Mathematics 31 or 33.

Learning Objectives
Students successfully completing ME 83L will be able to:

(1) **describe** and **discuss** material properties and behavior in scientific and quantitative terms
(2) **understand** and **describe** the intimate link between material structure, properties and processing
(3) **apply** the fundamentals of chemical thermodynamics and heat and mass transfer to predict material properties quantitatively
(4)**integrate** objectives (1)-(3) to select an appropriate material for a given engineering application and to solve simple material design problems quantitatively.

Measurable Outcomes (assessment methods)
This course measures students' progress in meeting the above objectives by requiring them to:

(1) **select/propose** an appropriate material for a given engineering application under the constraint of certain performance requirements (homeworks, exams);
(2) **predict** the effect of thermal and mechanical treatments on the resulting structure/properties of engineering materials by applying an understanding of phase-diagrams and processing histories (homework, exams, lab reports);
(3) **apply** the principles of chemical thermodynamics to describe the driving force in material transformation processes (homeworks, exams, lab reports);
(4) **explain** the role of defects in controlling a variety of material properties (mechanical, thermal, electrical) (homeworks, exams);
(5) **analyze** heat and mass transfer problems in solids and to calculate simple heat and mass transfer problems (homeworks, exams);
(6) **conduct** selected materials testing experiments and describe in writing the results, demonstrating an understanding of the theory underlying the experimental methods (lab reports);
(7) **present** the results of materials testing experiments orally in front of an audience of peers (oral presentation);
(8) **integrate** analysis techniques and a basic understanding of material behavior to solve simple material design problems (homework, exams, lab report).

Grading

Midterm EXAM	25 %
Final EXAM	25 %
Laboratory *Hardness Testing (20%)* *Materials Selection I (10%)* *Optical Microscopy (15%)* *Fabrication & Characterization (10%)* *Metallography (10%)* *Materials Selection II (10%)* *Lab Practices (5%)*	25 %
Homework	20 %
Class participation	10 %
Total	105 %

Class Policies

Class participation is strongly suggested (although not enforced)

To avoid class disturbance:
you are suggested not to arrive late or leave earlier,
you are suggested to eat outside the classroom,
you are suggested to turn off cellphones and laptops, and
you are suggested to read magazines outside the classroom.
These policies will be enforced.

Academic dishonesty will be reported to the proper Dean. No exceptions.

Grading Policy

Missed exams will equal 0 % unless the student has been excused by the instructor and arrangements for a make-up exam have been made.

Homework assignments are due one week after their assignment.
Points will be deducted if the homeworks are incomplete.
Solutions to all problems will be posted OR handed out.
TA **TBA** is in charge of homework management.

Laboratory reports are due one week after the end of the experiment.
Points will be deducted if the reports are incomplete.
TA **Kristine Obusek** is in charge of laboratory management.

Problem Solving Suggestions

- FIND: What are you looking for?
- GIVEN: What information is supplied in the problem statement?
- DATA: What additional information is available form tables, figures, equations in the text, to solve the problem?
- ASSUMPTIONS: What are the assumptions made to solve the problem?
- SKETCH: What geometrical information is required? Visualize the problem!
- SOLUTION: A detailed step-by-step procedure. Do NOT enter numeric information until the final algebraic manipulation is completed. Check units and consistency.
- COMMENTS: Summarize the solution in words and comment on the consequences of the solution to the problem.

Special Needs

Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact the instructor personally as soon as possible in order to discuss accommodations necessary to ensure full participation and to facilitate the educational opportunity.

WARNINGS

- FOOD: no food allowed in classroom.
- DRINKS: drinks are allowed in safe containers (spilling equals cleaning).
- PHONES: ringing cellphones and pagers are destruptive for the class (turn them OFF or I will invite you out of the class).
- TARDINESS: being precisely on time is crucial. Tardiness is not tolerated. If you are late, do not enter the class and get the notes from your colleagues.
- MAKE-UP: if you know you are going to be absent with a valid excuse, make previous arrangements with the professor or TAs.
- ABSCENCE: being absent is not an excuse for not coming prepared to class. Answering teacher's questions is part of participation grade.
- CLASS-DISRUPTION: is sanctioned with expulsion from the class.
- EXTRA-CREDITS: **none**, no exceptions.
- CHEATING: cheating in tests/assignments/reports will be reported and sanctioned as honor code violation, no exceptions.
- ALL OF ABOVE: all of above affects your final grade.

Honor Code (`http://www.integrity.duke.edu/ugrad/student.html`)

The Duke Community Standard

Duke University is a community of scholars and learners, committed to the principles of honesty, trustworthiness, fairness, and respect for others. Students share with faculty and staff the responsibility for promoting a climate of integrity. As citizens of this community, students are expected to adhere to these fundamental values at all times, in both their academic and non-academic endeavors.

The Pledge

Students affirm their commitment to uphold the values of the Duke University community by signing a pledge that states: **1.** I will not lie, cheat, or steal in my academic endeavors, nor will I accept the actions of those who do. **2.** I will conduct myself responsibly and honorably in all my activities as a Duke student.

The Reaffirmation

Upon completion of each academic assignment, students will be expected to reaffirm the above commitment by signing this statement: "I have adhered to the Duke Community Standard in completing this assignment."[Student Signature]

Tentative Course Outline

Class Period	Topics	Sections/Chapter
1	Introduction	Chapter 1 and Handout
2–5	Mechanical Behavior	9.1–9.2, 9.4
6	Atomic Structure	2.1–2.2
7	Atomic Bonding in Solids	2.4–2.8
8-9	Crystal Structures I	3.1–3.7
10	Crystal Structures II	3.8, 3.12
11–12	Defects	4.1-4.3, 5.1–5.4
13–15	Diffusion and Thermodynamics	4.4, and Handout
16–18	Electrical Behavior	Chapter 10
19–20	Optical Behavior	Chapter 11
21	MIDTERM EXAM	
22–26	Polymeric Materials	6.1–6.4, 6.6
27–31	Phase Equilibria	7.1–7.8
32–35	Phase Transformations/ Microstructure	8.1–8.3
36	Deformation Mechanisms	9.6
37	Strengthening/ Hardening	5.5
38–39	Processing and Design	5.5
40–42	Composite Materials	Chapter 14
	FINAL EXAM	Comprehensive