Boston University College of Engineering

Introduction to Materials Science

Spring 2023

Instructor: Prof. Keith A. Brown
Office: 8 St. Mary's Street, Rm 920
Email: brownka@bu.edu
Phone: 617-353-4841
Office Hours: M 11:30 AM to 12:30 PM in PHO 920 – or by appointment

Lecture: TR 1:30-3:15 PM in WED 130
Lectures are in person only and not recorded

Discussions: F 1:25-2:15 in KCB 104
F 2:30-3:20 in KCB 104

Homework Help Session: M 5:00-8:00 PM in EMB 121

Labs: C1 – M 8:00 AM - 9:45 AM ENG 113B
C2 – T 9:00 AM – 10:45 AM ENG 113C
C3 – W 4:30 PM – 6:15 PM ENG B01
C4 – R 9:00 AM – 10:45 AM ENG 113C

Teaching Assistants: **Lead:** Kaixin Suo (kxsuo@bu.edu)
Support: Haoxiang Yu (haoxiang@bu.edu)

Course Materials and Resources:

Textbook: "Materials Science and Engineering: An Introduction" 9th Edition or Etext, by William D. Callister, Jr., John Wiley and Sons 2013
Companion to material presented in class and example problems

Blackboard: http://learn.bu.edu
Assignments, announcements, lecture slides, and your grades

Gradescope: https://www.gradescope.com/
Submission of assignments

Piazza: https://piazza.com/
Forum for open discussion between students and instructors

Course Description: Structure and properties of solids; crystalline structure; defect structures; atom movement and diffusion; nucleation and growth; deformation; phase diagrams; strengthening mechanisms; heat treatment; ferrous/nonferrous alloys; ceramics; polymers; composites. Includes lab.

Prerequisites: PY 212 and CH 131 recommended

Course Topics:

Section 1: Atoms to Elasticity
Section 2: Slip Planes and Plasticity
Section 3: Microstructure and the Strength/Ductility Compromise
Section 4: Defects, Diffusion, and Advanced Properties

Course Outcomes:
As an outcome of completing this course, students will:

Gain an understanding of the fundamental principles of materials science.
Gain exposure to different classes of engineering materials.
Gain laboratory experience in the area of processing/structure/property correlations in materials.
Gain a clear understanding of laboratory safety issues and practices.

Course Grading:
Grading for ME 306 is broken down as following:

Homework	20%
Lab Reports:	15%
Quizzes:	20%
Exam 1:	20%
Exam 2:	20%
Participation:	5%

It is the student's responsibility to make sure that all grades are recorded correctly (on blackboard). Inquiries about scores will be accepted up to 2 weeks after they have been posted. Beyond that, there will be no change in grades.

Homework: One of the best methods to learn the material is to read the text before the material is presented in class, attend and pay attention in class, and work through the assigned problem sets. The course is structured to give you ample feedback regarding your understanding of the material through the problem sets and quizzes. By working through the problem sets, you will prepare yourself for the in-class quizzes, which themselves serve as preparation for exams. Assistance and worked examples will be provided in discussion and the homework review sections, so please seek out help if you need it!

Another helpful practice is to alternate teaching the problems to your classmates, which will force you to think about how to tackle and solve a problem. It is common for engineers to work in groups, so keeping in mind the Ethics Code, we encourage you to form groups to work out (but not copy) the problem sets. The quizzes and exams are solo efforts, however, so it is in your best interest to make sure you understand the problem set and not rely too heavily on your classmates or the GSTs.

Problem sets are due Monday at 11:59 PM via Gradescope. Typed solutions or clearly legible photographs of hand-written solution sets are acceptable.

Quizzes: (~15 mins) Will be *based* on the homework problems, and will be administered during the Thursday lecture *following* the homework due date. Your problem sets will likely not be graded and returned to you before the quiz, so please study the posted solutions to the problem sets in order to prepare for the quiz. *The lowest score will be dropped.*

Exams: There will be 2 in class examinations. They will take up the entire class period.

Exam 1: Covering Lectures 1-12	Thursday 3/14
Exam 2: Covering Lectures 14-25	Final exam week

Make-up exams will be given only in extreme circumstances. It is your responsibility to let your instructor know as far in advance as possible of an unavoidable conflict or medical emergency.

DO NOT MAKE TRAVEL PLANS FOR THESE DATES.

If you qualify for extended time on exams, per evaluation from the Office of Disability Services, it is your responsibility to present your documentation to your instructor at **least** a week before the exam/quiz. We cannot accommodate last-minute requests (less than a week prior to quizzes/exams) for extended time.

Discussion Sections: Discussion sessions are optional and will focus on Q&A related to homework and worked examples beyond those in lecture.

Homework help sections: There will be homework help sections before the deadline of every problem set. These are staffed by a GST who will be available to answer questions about the problem sets. The date and time of these will be determined through student poll.

Labs: There will be two laboratory assignments that will be done throughout the semester.

- Each student has an assigned laboratory time and must attend these during the two scheduled lab meetings listed below.
- While students may work in teams while performing experiments, individuals are responsible for handing in reports and their report must reflect their own work.
- Late reports WILL NOT be accepted without prior approval of Prof. Brown. Note that GSTs are not permitted to grant extensions and all such requests must go through Prof. Brown.
- Submission of labs is through gradescope and it is the responsibility of the student to make sure that lab files can be opened and read without issue.

Laboratory Schedule

Week 1	1/23	No Lab
Week 2	1/30	No Lab
Week 3	2/6	No Lab
Week 4	**2/13**	**Diffraction Lab (due 3/14)**
Week 5	2/20	No Lab
Week 6	2/27	No Lab
Week 7	3/13	No Lab
Week 8	3/20	No Lab
Week 9	3/27	No Lab
Week 10	4/3	No Lab
Week 11	**4/10**	**Diffusion Lab (due 5/2)**
Week 12	4/17	No Lab
Week 13	4/24	No Lab
Week 14	5/1	No Lab

Classroom Courtesy: To preserve an open and distraction-free learning environment for all students, the following policies apply:

- Please respect all BU COVID policies
- Cell phone use is not permitted in class. This includes calls, texting, web browsing, games, etc.
- Students disrupting class or distracting their classmates will be asked to leave the classroom.

Boston University Academic Conduct Code*:* Honesty is a core value of Boston University. Any violations of the BU academic honesty and integrity standards ***will be pursued*** through appropriate University channels. This includes, but is not limited to: cheating, plagiarism and misrepresentation. If you have any questions as to what constitutes an honor code violation, please ask. ***Ignorance is not an excuse for cheating***. You may access the BU Academic Conduct Code at:
http://www.bu.edu/academics/policies/academic-conduct-code/

Section 1		**Atoms to Elasticity**		
Section 2		**Slip planes and Plasticity**		
Section 3		**Annealing and the Strength/Ductility Compromise**		
Section 4		**Defects, Diffusion, and Advanced Properties**		
L #	**Reading**	**Date**	**Topic**	**Notes**
1	C1	1/19	Introduction and Materials Design	HW1 (1-3) out, due 1/30
2	C6:1-5	1/24	Elastic Mechanics	
3	C2:1-4	1/26	Atomic Structure & the Periodic Table	
4	C2:5-10	1/31	Atomic Bonding	HW2 (4-5) out, due 2/6
5	C3:1-8	2/2	Crystal Structures and Points	Quiz 1 on Lecs 1-3
6		2/7	Emergence of Elasticity	HW3 (6-7) out, due 2/13
7	C6:6-12	2/9	Plastic Mechanics	Quiz 2 on Lecs 4-5
8	C3:9-12	2/14	Crystallographic Directions and Planes	HW4 (8-10) out, due 2/27
9	C3:11-17	2/16	Planes pt 2 and X-Ray Diffraction	Quiz 3 on Lecs 6-7
10	C7:1-7	2/23	Dislocations and Slip	
11	C7:8-13	2/28	Strengthening Mechanisms in Metals	HW5 (11-12) out, due 3/13
12	C15:1-9	3/2	Plasticity in Polymers	Quiz 4 on Lecs 8-10
13		3/14	Exam 1 Review	
		3/16	Exam 1 on Lecs 1-12	
14	C8:1-6	3/21	Fracture	HW6 (14-15) out, due 3/27
15	C9:1-10	3/23	Phase Diagrams: Binary Isomorphous	
16	C9:11-12	3/28	Phase Diagrams: Binary Eutectics	HW7 (16-17) out, due 4/3
17	C9:18-20	3/30	Phase Diagrams: Iron-Carbon	Quiz 5 on Lecs 14-15
18	C10	4/4	Phase Transformations	HW8 (18-19) out, due 4/10
19	C8:7-15	4/6	Fatigue	Quiz 6 on Lecs 16-17
20	C6:10,C17,C4:4-11	4/11	Surface Properties	HW9 (20-21) out, due 4/17
21	C5:1-5	4/13	Diffusion and Fick's Laws	Quiz 7 on Lecs 18-19
22	C4:1-3	4/18	Imperfections in Solids	HW10 (22-23) out, due 4/24
23	C12:1-7	4/20	Structure and Defects of Ceramics	Quiz 8 on Lecs 20-21
24	C16	4/25	Composites	HW11 (24-25) out, due 5/1
25		4/27	Advanced Topics	Quiz 9 on Lecs 22-23
26		5/2	Final Exam Review	
Final Exam period			Exam 2 on Lecs 14-25	