MSE 45L – Properties of Materials Laboratory | Fall 2020

Instructor: Lane W. Martin
Laboratory Exercises are Virtual/Remote, recorded for asynchronous review
Laboratory "Lectures" are Virtual/Remote, recorded for asynchronous review

Email:	lwmartin@berkeley.edu
Office:	216 Hearst Mining Building (but I won't be there)
Office Hours:	Monday 3:00-4:00PM, Wednesday 9:30-10:30AM
Course Website:	bCourses
Graduate Student Instructors:	Mallika Bariya (m.bariya@berkeley.edu; OH: Mon. 4:00-5:00P; 102|106) Vishal Ravi (vishalravi@berkeley.edu; OH: Thur. 2:00-3:00P; 101|104) Renjie Tao (tao_renjie@berkeley.edu; OH: Wed. 1:00-2:00P; 103|105) All GSI office hours will be virtual
Laboratory Sections:	Sec. 101 – Tuesday 8:00-11:00AM | Sec. 102 – Tuesday 2:00-5:00PM Sec. 103 – Wednesday 2:00-5:00PM | Sec. 104 – Wednesday 8:00-11:00AM Sec. 105 – Friday 8:00-11:00AM | Sec. 106 – Thursday 2:00-5:00PM

Text: *Materials Science and Engineering: An Introduction,* William D. Callister, Jr. and David G. Rethwisch, 9th or 10th Edition, Wiley: Hoboken, NJ (2014).
*The 9th Ed. was used in F/S 2016, F/S 2017, F/S 2018, F/S 2019, & S 2020.
** Not required for students taking MSE45L only.

References: A number of texts are on reserve at the Engineering Library, including:

- Materials Science and Engineering: An Introduction (9th Ed., 2014), W. D. Callister, Jr. and D. G. Rethwisch (our book)
- Materials Science and Engineering: An Introduction (8th Ed., 2010), W. D. Callister, Jr. and D. G. Rethwisch
- Introduction to Materials Science for Engineers (7th Ed., 2009), J. F. Shackelford (2 copies)

Prerequisites: Some basic chemistry, physics, and math; MSE 45 (at least concurrently)

Description & Objectives: This 1-unit course consists of one (1) 1-2-hour laboratory safety and ethics training session, five (5) 3-hour laboratory experiences occurring every other week led by the GSIs, and five (5) 1-hour mandatory "lecture" sessions (occurring the week prior to laboratory experiences) in which information about the laboratory experiments will be taught. The objectives of this course are to provide undergraduate materials science and engineering and other engineering and science students hands-on experiences in foundational materials science topics and to serve as a practical extension to the lecture-based course MSE 45. MSE 45 provides broad coverage of the field for non-majors who may not take another course in the field and it serves as the introductory course in the major field, laying the foundation for understanding the relationship between the internal structure of matter and the properties of materials that make them attractive for engineering applications. This course will apply these basic principles in a laboratory setting while provide practice writing, ethics, and other skill sets.

Connection to MSE45: MSE45 is a stand-alone, lecture based course that supports an additional laboratory-based based class, MSE45L. MSE45L is a laboratory-based experience that augments the topics of the MSE45 lecture class with hands-on practical experiences. Students taking MSE45 are not required to take MSE45L (although it is recommended), but those taking MSE45L must have already completed or be taking MSE45 concurrently.

Proposed Class Structure, Outline, and Schedule

As with all things in our lives, COVID-19 has led to marked changes in how we interact and learn. Due to restrictions on in-person teaching, we have transitioned fully to remote/virtual instruction for the duration of the semester. The following provides a proposed and potentially evolving vision of how we will provide a virtual laboratory experience. This could potentially change as we gain more experience and input from you all.

Proposed Class Structure

We have adapted the two-week laboratory cycle for the virtual environment. For most labs, week 1 will include a "live", Zoom-based lecture (~45-50 minutes in duration) occurring during your laboratory time slot. Students must attend the live airing of the Zoom-based lecture if at all possible – attendance will be taken. Those who might be in a time zone that makes real-time attendance difficult will be offered the opportunity to watch the recorded lecture, but will need to complete a "quiz" to confirm their understanding of the topics. In week 2, the laboratory will be presented in a real-time, Zoom-based "watch-party" style. Your GSI will have a pre-recorded version of the laboratory (produced by our class staff, averaging ~1-1.5 hours) and will escort you through the experiment, providing real-time insights, teaching, and answers to questions you might have about the materials, procedures, etc. Again, students must attend the live airing of the Zoom-based lecture if at all possible – attendance will be taken. Those who might be in a time zone that makes real-time attendance difficult will be offered the opportunity to watch the recorded session, but will need to complete a "quiz" to confirm their understanding of the topics. Only once you have attended the live session or watched the laboratory and completed the quiz, will students be provided the data for the laboratory. We hope that this structure provides students both with contact and interaction with your GSI and fellow students, but also an opportunity to get insights from somebody who will have done the lab themselves.

Class Outline

Laboratory 1: Laboratory Safety and Ethics

- Introduction to best-practices and approaches to safe laboratory work.
- Introduction to concepts of professional engineering ethics, case studies.

Laboratory 2: Recovery, Recrystallization, and Grain Growth

- To measure and compare the hardness of metallic samples.
- To understand the fundamental concepts of mechanical stress and strain.
- To illustrate the use of thermal treatments in the restorative processing of materials that have been shaped by mechanical deformation.
- To understand the detailed microstructural changes occurring during the three stages of annealing.

Laboratory 3: Binary Alloy Phase Diagrams

- To understand how phase diagrams are constructed from cooling curves.
- To compare the as-solidified microstructures of different alloys in binary alloys systems.

Laboratory 4: Heat Treatment of Steel

- To understand the effect of thermal processing (heat treatment) on both the microstructure and properties (hardness) of steel.
- To understand the application of time-temperature-transformation (TTT) curves in ferrous metallurgy.

Laboratory 5: The Uniaxial Tensile Test

- To illustrate the basic properties of strength and toughness of materials.
- To standardize the fundamental concepts of mechanical stress and strain.
- To understand the uniaxial tensile test and the generation of "Stress-Strain" curves.
- To observe the microstructure of a fracture surface obtained in a Charpy impact test.

Laboratory 6: Electronic Properties of Materials

- To understand the nature of electrical conductivity in materials.
- To investigate the change of electrical resistivity with temperature in metals, semiconductors, and insulators.
- To determine the relationship between electrical resistivity and the presence of impurities in these materials.

Class Schedule

Date	AM Lab	PM Lab	Assignments Due
Aug. 24	No School		
Aug. 25	No School		
Aug. 26			
Aug. 27			
Aug. 28			
Aug. 31			
Sep. 1	Lab 1 (101)	Lab 1 (102)	
Sep. 2	Lab 1 (104)	Lab 1 (103)	
Sep. 3		Lab 1 (106)	
Sep. 4		Lab 1 (105)	
Sep. 7			
Sep. 8	Lab 2 Lecture	Lab 2 Lecture	Lab 1 Report
Sep. 9	Lab 2 Lecture	Lab 2 Lecture	Lab 1 Report
Sep. 10		Lab 2 Lecture	Lab 1 Report
Sep. 11		Lab 2 Lecture	Lab 1 Report
Sep. 14			
Sep. 15	Lab 2 (101A)	Lab 2 (102A)	
Sep. 16	Lab 2 (104A)	Lab 2 (103A)	
Sep. 17		Lab 2 (106A)	
Sep. 18		Lab 2 (105A)	
Sep. 21			
Sep. 22	Lab 3 Lecture	Lab 3 Lecture	Lab 2 Report
Sep. 23	Lab 3 Lecture	Lab 3 Lecture	Lab 2 Report
Sep. 24		Lab 3 Lecture	Lab 2 Report
Sep. 25		Lab 3 Lecture	Lab 2 Report
Sep. 28			
Sep. 29	Lab 3 (101A)	Lab 3 (102A)	
Sep. 30	Lab 3 (104A)	Lab 3 (103A)	
Oct. 1		Lab 3 (106A)	
Oct. 2		Lab 3 (105A)	
Oct. 5			
Oct. 6	Lab 4 Lecture	Lab 4 Lecture	Lab 3 Report
Oct. 7	Lab 4 Lecture	Lab 4 Lecture	Lab 3 Report
Oct. 8		Lab 4 Lecture	Lab 3 Report
Oct. 9		Lab 4 Lecture	Lab 3 Report
Oct. 12			
Oct. 13	Lab 4 (101A)	Lab 4 (102A)	
Oct. 14	Lab 4 (104A)	Lab 4 (103A)	
Oct. 15		Lab 4 (106A)	
Oct. 16		Lab 4 (105A)	
Oct. 19			
Oct. 20	Lab 5 Lecture	Lab 5 Lecture	Lab 4 Report
Oct. 21	Lab 5 Lecture	Lab 5 Lecture	Lab 4 Report
Oct. 22		Lab 5 Lecture	Lab 4 Report
Oct. 23		Lab 5 Lecture	Lab 4 Report
Oct. 26			
Oct. 27	Lab 5 (101A)	Lab 5 (102A)	
Oct. 28	Lab 5 (104A)	Lab 5 (103A)	
Oct. 29		Lab 5 (106A)	

Oct. 30		Lab 5 (105A)	
Nov. 2			
Nov. 3	Lab 6 Lecture	Lab 6 Lecture	Lab 5 Report
Nov. 4	Lab 6 Lecture	Lab 6 Lecture	Lab 5 Report
Nov. 5		Lab 6 Lecture	Lab 5 Report
Nov. 6		Lab 6 Lecture	Lab 5 Report
Nov. 9			
Nov. 10			
Nov. 11	No Class – Academic & Administrative Holiday		
Nov. 12			
Nov. 13			
Nov. 16			
Nov. 17	Lab 6 (101B)	Lab 6 (102B)	
Nov. 18	Lab 6 (104B)	Lab 6 (103B)	
Nov. 19		Lab 6 (106B)	
Nov. 20		Lab 6 (105B)	
Nov. 23			
Nov. 24			
Nov. 25-27	No Class – Academic & Administrative Holiday		
Nov. 30			
Dec. 1			Lab 6 Report
Dec. 2			Lab 6 Report
Dec. 3			Lab 6 Report
Dec. 4			Lab 6 Report

Grading Policies

There are no individual thresholds assigned to the different components of your grade. All components are scored, weighted, pooled, and then **mapped onto a curve for a course grade determination at the end of the semester**. Student learning and growth will be assessed based on the following assignments:

- **Laboratory Time and Laboratory Reports (90% to total grade, 18% for each report)**
  - There are 6 laboratory sections for MSE45L each week (as noted in the table below).

MSE 45L Labs	Tuesday	Wednesday	Thursday	Friday
8:00-11:00AM	101 Prim.: Ravi	104 Prim.: Ravi		
2:00-5:00PM	102 Prim: Bariya	103 Prim.: Tao	106 Prim: Bariya	105 Prim: Tao

  - All laboratory sections will be virtually in Zoom sessions to be created by your GSI.
  - The six laboratory exercises complement the lectures offered in MSE45 in biweekly experiments investigating the properties of materials. Refer to the *Laboratory Guide* and *Laboratory Manuals* on bCourses. The labs include:
    - Laboratory 1: Laboratory Safety and Ethics
    - Laboratory 2: Recovery, Recrystallization, and Grain Growth
    - Laboratory 3: Binary Alloy Phase Diagrams
    - Laboratory 4: Heat Treatment of Steel
    - Laboratory 5: The Uniaxial Tensile Test
    - Laboratory 6: Electronic Properties of Materials
  - All students ***must complete the Laboratory 1 report***, but students can drop one score (or simply not do) one of Laboratory 2, 3, 4, 5, or 6 reports. In other words, ***only 5 of the 6 reports are required to get a full grade***. Those completing all 6 reports will receive the summation of the best 5 scores from all assignments.

- Each laboratory section will be staffed by a primary Graduate Student Instructor (GSI) who is responsible for grading laboratory reports and providing a lecture about that laboratory for that section.
- Reports must be completed following the guidelines outlined in the ***Laboratory Guide*** (available online).
- Laboratory reports are to be submitted electronically through bCourses and are due 1 week from the start of your laboratory.
  - Example if you are in laboratory section 102, your report will be online by 2:00PM on the next Tuesday.
- Laboratory grading concerns – After your graded lab reports are returned, you may notice differences in scoring between lab sections. Sometimes one GSI may appear to be stricter in the grading than another. This is a natural result of the variability of the graders. To account for this, at the end of the semester all lab scores are normalized and treated based on average and standard deviation values for the different sections. This removes any variations in grading styles among lab sections.

- Laboratory and Lecture Section Participation (10% of total grade)
  - Your virtual attendance in Lecture and Laboratory is essential to the success of this class – as such attendance at ***all of your registered sections*** (that is both the lecture and laboratory exercise for Laboratories 1, 2, 3, 4, 5, and 6) are ***mandatory***. Even if you plan to "drop" a specific laboratory report, you must attend and participate in the laboratory lecture and exercise.
  - You will be assess based on participation in those sections for a portion of your grade.
    - One (1) unexcused absence will result in a reduction of your overall grade by one (1) letter grade.
    - Two (2) unexcused absences will result in a failing grade for MSE 45L.
  - Students must attend the live airing of the Zoom-based lecture and laboratory "watch parties" if at all possible – attendance will be taken at the conclusion of that lecture. If you attend the real-time exercise, you will satisfy the requirement for "attendance". This said, we recognize that some students might either have a periodic time conflict, have issues accessing the internet at a specific, time, be in a time zone that makes real-time attendance difficult, etc. As such, we will record each section and make that recording available to all students. Those who cannot attend in person will be offered the opportunity to watch the recorded session, but will need to complete a "quiz" to confirm their understanding of the topics.
    - Details of the quizzes will be determined by your GSI, but could include an actual written quiz, a verbal quiz with the GSI etc.
    - Lab Lecture – Students must watch the recorded lecture and complete the quiz to gain credit for the Lab Lecture by the deadline provided by the GSI; failure to do will result in an unexcused absence.
    - Lab Exercise "Watch Party" – Students must watch the recorded lecture and complete the quiz to gain credit for the Lab Exercise by the deadline provided by the GSI; failure to do will result in an unexcused absence and will mean that the students will not be given the data to complete the lab report and thus any work will not be accepted for that lab.

Late Assignments

- No late assignments will be accepted unless prior arrangements are made with the instructor for valid excuses.
  - Valid excuses include, but are not limited to, deaths in the family, jury duty, hospitalization for illness, etc. Valid proof of absences can and will be requested.
  - Non-valid excuses include, but are not limited to, oversleeping, "my internet didn't work," "I wasn't here when you assigned it," etc.
- Unreadable or corrupted files cannot be replaced later on – we will grade what is uploaded by the due date and time. No late laboratory reports will be accepted. No late versions to replace missing sections or unreadable or corrupt files will be accepted.

- If you have concerns I am happy to discuss with you about your specific situation and clarify any questions you have.

Re-grading Policy

- Re-grading of exams, reports, and homeworks is a timely and serious undertaking. The Instructor takes the academic integrity of this course and your work very seriously. In turn, you will be asked to take a similar stance on these materials. In order to assure only valid cases come before the class staff, the following policies will be in place. Failure to adhere to these policies will mean that your requests will go unheeded:
  - All re-grading requests must be made within ***1 week (7 days)*** from the time the assignment grades/solutions are made available to the student.
  - Students are required to type up a written request for re-grading. This request should including the following information:
    - Student Name and ID
    - Assignment or Exam in question
    - Problem number in question
    - A written description, using complete sentences, out-lining the suspected mis-grading. This includes a detailed description of what you have done and why you think it merits a re-grade.
  - Re-grade request along with the original assignment/exam will first go to the Instructor (this is Prof. Martin for MSE 45 and your respective GSI with a cc to Prof. Martin for MSE 45L) for consideration. At this point the Instructor can reject re-grade requests that do not meet the above standards. Compliant requests will then go to the appropriate grader or GSI who will consider the request.
    - Simple fixes such as addition errors will be rectified immediately.
    - More extensive requests will go to the appropriate grader or GSI who will then consult with the Instructor with one of two outcomes: 1) a complete re-grade of the entire assignment or 2) rejection of the appeal. Note that complete re-grading may under other errors on other problems that could lower or increase your grade further.
  - The results of this re-grading will be final and binding.
  - Attempts to "doctor" or manipulate assignments after grading to enhance scores will be dealt with under the auspices of the Academic Code of Conduct.

Academic Code of Conduct

- This course will execute a "zero-tolerance" policy concerning cheating and plagiarism.
- Students are referred to the University of California, Berkeley Student Code for complete details on the Student Code. Special attention should be given to Section V and Appendix II of (http://sa.berkeley.edu/code-of-conduct).
- Cheating and plagiarism will be dealt with according to established campus policy. Students caught cheating will receive a failing grade.