

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

Hours

Lecture	All	M and W	1:30pm –2:20pm	MATH 175
Lab Pre/ Activities	All	F	1:30pm –2:20pm	MATH 175
Labs	DIV 2	M	9:30am - 11:20am	HAMP G150C (Lyles i2i Lab)
	DIV 4	M	3:30pm - 5:20pm	HAMP G150C (Lyles i2i Lab)
	DIV 6	T	9:30am - 11:20am	HAMP G150C (Lyles i2i Lab)
	DIV 7	T	11:30am - 1:20pm	HAMP G150C (Lyles i2i Lab)
	DIV 12	T	1:30pm - 3:20pm	HAMP G150C (Lyles i2i Lab)
	DIV 8	T	3:30am - 5:20pm	HAMP G150C (Lyles i2i Lab)

Instructor: Prof. Pablo Zavattieri, Office: HAMP G217, Phone: 496-9644, e-mail: zavattie@purdue.edu, web site: <http://engineering.purdue.edu/~zavattie>

Office hours: Monday-Wednesday 3:00-4:00pm, whenever I am in my office, or by appointment.

Teaching Assistants:

Warda Ashraf (DIV 2)	washraf@purdue.edu	Office: HAMP G223	Office hours: M 2:30-3:30pm
Belayneh Desta (DIV 6 & 7)	desta@purdue.edu	Office: HAMP G223	Office hours: T 2:00-4:00pm
Chanhue Jeong	jeong4@purdue.edu	Office: HAMP G144	Office hours: TBD
Hyung Jun Ahn (DIV 12)	ahn16@purdue.edu	Office: HAMP G223	Office hours: T 12:00-1:00pm
Arash Memarnahavandi (DIV 4 & 8)	amemarna@purdue.edu	Office: HAMP G144	Office hours: W 3:00-5:00pm

Lab Manager: William Schmidt, (765) 494-2249, schmidwj@purdue.edu

Course information will posted on **Blackboard Learn:** <https://mycourses.purdue.edu/>

Textbooks:

Calister W.D., Rethwish, D.G., “Materials Science and Engineering: An Introduction”, 9th Ed. WileyPLUS ([More information to come](#)). This book will not be needed until approximately Spring Break.

Not required:

Hibbeler, R. C., “Mechanics of Materials” 9th Ed. Prentice Hall, Upper Saddle River, NJ (older editions are also fine)

Other requirements:

- We will make use of the *i>Clicker* technology in the lectures, and most of the labs to encourage participation and critical thinking about what is being learned in class.
<http://www.itap.purdue.edu/learning/tools/iclicker/>
- Safety Glasses. More information on Lab Safety and rules will be given in the first Lab Preparation class.

CE 231: Engineering Materials I (Spring 2016)

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Course Objectives

The objective of this course is that by the end of the semester the student will be able to successfully utilize fundamental material science and mechanics concepts to understand, explain, and describe the performance of a wide range of engineering materials. The student will be able to describe and predict the mechanical response of a material under an arbitrary state of stress. The student will be able to assess the failure behavior of different materials and describe this behavior based on mechanics and material science arguments that will include microstructural evidence, failure theories, and material composition. In addition, the student will be able to successfully implement, analyze, and report on laboratory tests performed on typical civil engineering materials. These objectives will be achieved through weekly laboratory and homework exercises.

Topics Covered

An introduction to the fundamental concepts of stress and strain, the basis for material elasticity from both the theoretical and physical point of view, atomic structure and its influence on material properties, the fundamental of brittle behavior, yielding, and material plasticity, strength behavior and yield criteria, fracture and toughness, behavior of materials under fatigue loading, ductile strengthening, corrosion.

ABET Outcome Criteria:

- a- an ability to apply knowledge of mathematics, science, and engineering
- b- an ability to design and conduct experiments, as well as to analyze and interpret data
- c- e- an ability to identify, formulate, and solve engineering problems

GENERAL POLICIES AND RULES

Read these rules CAREFULLY. It will be assumed that you have read this material and understood it.

Attendance

Students are expected (required) to attend all classes, laboratory sessions, and examinations. Students are expected to attend and actively participate in weekly laboratory sessions, consisting of either problem solving sessions or running experiments. You are expected to have read the reading assignment or watch the required videos before you come to lecture or labs. Students should expect short, unannounced quizzes. Important lab information and class activities will take place on Fridays. Attendance is very important on those dates.

Lab attendance and punctuality is very important. Students are expected to arrive to their respective lab sessions 5 minutes before the beginning of the lab. Students who arrive 5 minutes late will not be able to collect participation points (typically associated with i>Clicker questions). No student will be allowed to get in the Lyles i2i after 10 minutes of the beginning of the class.

Labs will not be able to be made up except in the case of EXTREME circumstances. If you have a foreseeable conflict please contact Prof. Zavattieri WELL BEFORE the scheduled lab and possible options can be discussed.

Laboratory Reports/Homework

All homework is to be in a format that would be consistent with professional engineering practice. An example will be provided. All homework is to be submitted on either plain (i.e., unlined paper) or engineering paper with the problem worked only on one side of paper. All the sheets should contain the student's name.

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

assignment number, division number (of the enrolled division) and the problem number. In addition it is anticipated that the problem will contain a clear description of the problem including what are the problem givens, nomenclature, and the unknowns. In addition a sketch of the problem is needed as well as a free body diagram whenever applicable (straight-edges are to be used in constructing these diagrams). The solution is to be worked in an organized manner with relevant calculations and notes as appropriate. The problem is to be worked methodically down the page. The answer is to be placed in a box at the end of the problem containing units. The details of your calculations must be shown for all problems that involve calculations. A result may be graded as completely wrong if given without supporting calculations. Any numerical result or answer that requires a unit is incorrect, and will be counted as such, if that unit is omitted or given incorrectly. Example: 50 is not the same as 50 mph or 50 km/hr. Each problem is expected to begin on a new page. You are expected to understand the concept of significant figures and to use the proper number of significant figures in the final statement of your lab results. Finally, all pages are to be stapled together before submission. Failure to follow these guidelines may result in loss of credit regardless of the correctness of the answer.

Lab reports are due one week after you perform the experiment or one week after you get all the data needed for the report. These are due at the beginning of the appropriate class meeting. No late reports will be accepted. Lab reports should follow the required format. You need to attend the labs to submit a report. We will not be able to accept any report, if you did not attend your lab session.

Students are expected, even encouraged, to consult with one another on homework assignments and lab write-ups; however all work submitted by the student is expected to be their own effort (this includes plots, images, calculations, captions, text, etc.). If there is reason to believe that work has been copied from another student, university regulations may be invoked as regards punitive action. Furthermore, the Professor reserves the right to assign a failing grade for either the specific work or for the entire course.

Solutions to the Homework will be posted after the assignment is submitted. Problems will be graded for correctness or checked for completeness, regardless of approach or solution at the discretion of the Instructor.

Exams

All exams are closed book, closed notes. Relevant formulas will be provided with the exam; a sample of which equations will be provided will be posted prior to the test. Programmable calculators are permitted; however grading will be based solely on the information shown on the exam sheet. For this reason all necessary steps, figures, and calculations are to be shown in order to obtain credit. All work that you submit must be strictly your own. If there is reason to believe that work has been copied or done in collaboration with another student, university regulations may be invoked as regards punitive action. Instances of cheating during exams will result in full loss of credit for that exam. Additional measures including the immediate failure of the course may be applied at the discretion of the instructor and/or University Staff.

Make-Up Exams

There will be NO MAKE UP EXAMS in this course. Any student absent from an exam will receive a score of "zero" for the exam, unless the absence was related to a substantive personal or family health emergency. The dates of the exams are indicated on the syllabus. Therefore, all travel plans associated within or outside the university functions shall be made with this policy in mind. Any student missing an exam due to a substantive personal or family health emergency shall provide a written letter from a physician or a recognized individual authenticating the seriousness of the emergency and how it led to the student's absence from the exam. The letter should state the specific reason for the absence and the date and duration of the incident. The letter shall include the name, title, relationship to the student, address, and telephone number of the letters author. In such case, the instructor reserves the right to accept or decline the excuse.

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

Grading

Exams (3 exams)	50%
Homework and Quizzes	10%
Activities, quizzes & iClicker	10%
Laboratory Reports	30%

Important:

- In order to pass the course, a 150 actual exam points (out of a total 300 points) is required. Failure to accumulate that minimum number of actual exam points will result in a grade of F, regardless of the overall average computed from all completed assignments.
- You are also required to submit a minimum of 80% of lab reports. Less than 80% of Lab reports will also result in a grade of F.

The course is NOT graded on A CURVE. Final letter grades are assigned based on the total number of percentage points accumulated. These percentage points are weighed so that the approximate breakdown looks as follows: As a guide, letter grades will generally be assigned as follows: Total percentage in the 90's- A, 80's- B, 70's- C, 60's- D, below 60's- F; providing that you have accumulated the minimum number of points needed for passing the course (150), and minimum number of lab reports. "+" and "-" will be adopted.

You are welcome to discuss any grade with Prof. Zavattieri. It is important that this is done shortly after the graded work is returned. There will be no general review of prior work to find "extra points" toward the end of the semester. You are free to contest laboratory, homework, or exam grades; however this must be done in writing and submitted in person to Prof. Zavattieri. This written explanation should include the location of the problem you are requesting review for along with a where the error is believed to have occurred. The item in dispute must be submitted before the end of the first lecture following the return of the homework, lab assignment, or lecture.

It is important that you always check your grades on Blackboard, and estimate your own overall grade. If you have questions or concerns about your grades, or performance in general, contact Prof. Zavattieri.

Academic Integrity:

Academic integrity is expected of all students at all times. Information on what constitutes academic integrity may be found in the handbook University Regulations. Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

Information on what constitutes academic integrity may be found in the Purdue's student guide for academic integrity (<http://www.purdue.edu/odos/academic-integrity/>)

Use of Copyrighted Materials

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be “derivative works” of the instructor’s presentations and materials, and they are thus subject to the instructor’s copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity. See the following website for additional information: <http://www.purdue.edu/policies/>

Students with Disabilities

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three (3) weeks of the semester in order to discuss any adjustments. It is important that we talk about this at the beginning of the semester. It is the student's responsibility to notify the Disability Resource Center (<http://www.purdue.edu/drc>) of an impairment/condition that may require accommodations and/or classroom modifications.

Nondiscrimination

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

Emergency Procedures:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Information will be provided via email and/or Blackboard. If a student suspects he or she may have symptoms associated with the swine flu, you are encouraged to seek medical help and not come to class. Please see Purdue's Emergency Preparedness website at http://www.purdue.edu/emergency_preparedness/index.html, and the [Adverse Winter Weather Procedures and Announcements](#).

Emergency exist plans have been prepared for all classrooms located in engineering buildings. The following link provides critical information Evacuation and Shelter-in-place for our main classroom MATH 175: <https://www.math.purdue.edu/about/building>

Here are ways to get information about changes in this course:

- Course information on Blackboard: <https://mycourses.purdue.edu/>
- Instructors' contact information: Prof. Pablo Zavattieri, (765) 496-9644, zavattie@purdue.edu
- Instructors' web pages: <http://engineering.purdue.edu/~zavattie/teaching.html> (Only in case of Emergency)

Others

No food in the lab. Absolutely no cell phones in the classroom or lab.

Schedule

This is a tentative schedule and it is intended to be a guide. Students are expected to anticipate the topics that will be covered in class by attending the classes and following this guide. Any type of change to this schedule will be announced at the beginning of the class. The syllabus (and this schedule) will be kept updated on Blackboard.

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

Day	Date	Topic Covered
Mon, Tues	11-Jan	Introduction to the course / Forces and Equilibrium (Video)
Wed	13-Jan	Stress
Fri	15-Jan	Normal Stress
Mon, Tues	18-Jan	Martin Luther King Jr. Day
Wed	20-Jan	Shear Stress
Fri	22-Jan	Class Activity
Mon, Tues	25-Jan	Combined Stress
Wed	27-Jan	Stress 3D
Fri	29-Jan	Lab prep 1, Safety, Lab reports guidelines
Mon, Tues	1-Feb	Lab 1, Machine Operation & Material Variability
Mon	1-Feb	Stress Transformation - Plane Strain
Wed	3-Feb	Stress Transformation
Fri	5-Feb	Class Activity
Mon, Tues	8-Feb	Lab 2, Compression Testing
Mon	8-Feb	Principal Stress
Wed	10-Feb	Principal Stress
Fri	12-Feb	Class Activity
Mon, Tues	15-Feb	Lab 3, Hardness Test Lab
Mon	15-Feb	Mohr's Circle
Wed	17-Feb	Mohr's Circle
Fri	19-Feb	Class Activity
Mon, Tues	22-Feb	Lab 4 (Part A), Tensile Testing I
Mon	22-Feb	Mohr's Circle
Wed	24-Feb	Strain
Fri	26-Feb	Exam 1
Mon, Tues	29-Feb	Lab 4 (Part B), Tensile Testing II
Mon	29-Feb	Strain Transformation
Wed	2-Mar	Principal Strains
Fri	4-Mar	Class Activity
Mon, Tues	7-Mar	Lab 5, Torsion Test
Mon	7-Mar	Mohr's Circle for strain
Wed	9-Mar	Generalized Hooke's Law
Fri	11-Mar	Class Activity

CE 231: Engineering Materials I (Spring 2016)

Lyles School of Civil Engineering, Purdue University

Day	Date	Topic Covered
Mon, Tues	14-Mar	Spring break
Wed	16-Mar	
Fri	18-Mar	
Mon, Tues	21-Mar	Lab 6, Strain Measurement / Mohr's Circle
Mon	21-Mar	Generalized Hooke's Law
Wed	23-Mar	Atoms
Fri	25-Mar	Class Activity
Mon, Tues	28-Mar	Lab 7, Dynamic Impact Lab
Mon	28-Mar	Atomic bonding
Wed	30-Mar	Crystal Lattices
Fri	1-Apr	Theoretical Properties I
Mon	4-Apr	Exam 2
Wed	6-Apr	Theoretical Properties II
Fri	8-Apr	Lab 8 Prep- Finite Element Method (FEM)
Mon, Tues	11-Apr	Lab 8, Finite Element Lab
Mon	11-Apr	Defects, Thermal Process and Diffusion
Wed	13-Apr	Phase Diagram I
Fri	15-Apr	Thermal Process and Diffusion
Mon, Tues	18-Apr	Lab 9, Crystal Structures
Mon	18-Apr	Phase Diagram II
Wed	20-Apr	Phase Diagram (Fe-C) - steel
Fri	22-Apr	Class Activity
Mon, Tues	25-Apr	Lab 10, Non-Conventional Materials
Mon	25-Apr	Kinetics - Heat treatment I
Wed	27-Apr	Kinetics - Heat treatment II
Fri	29-Apr	Review
Final Exam		Week of Exams (May 2-7) - TBD