

## CEE300/TAM 324 -- Behavior of Materials -- Spring 2024

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Professor office hours (1116 Newmark): **Mon. 2-2:45pm** and **Thurs. 2-3pm** or by appointment

### Learning Objectives

- To understand how material properties are affected by chemical bonding and microstructure
- To explore the composition, microstructure, and behavior of important engineering materials
- To understand the effects of external stress on material behavior
- To become familiar with methods of testing engineering materials
- To improve technical writing and communication skills

### Materials

- **Required:** W.D. Callister Jr. and D.G. Rethwisch, *Materials Science and Engineering: An Introduction*, 10<sup>th</sup> ed. (John Wiley & Sons Inc. 2018) ISBN 978-1-119-40549-8 (available in the bookstores). The 9<sup>th</sup> edition is also acceptable. **See note below about book rental.**
- **Required:** J.S. Popovics and L.J. Struble, eds., *Behavior of Materials --Laboratory Notes, Spring 2023* (provided electronically)--**Note that earlier editions are obsolete**
- **Required:** Protective eyewear, with side shields, meeting ANSI Z87.1 (available in university bookstores)
- **Required:** Any notes or handouts distributed through the course Canvas site

**Note regarding the textbook:** A fully electronic version semester-long "rental" of the book is available for purchase for \$50, directly from the publisher; more information can be found here: <https://www.wiley.com/en-us/Materials+Science+and+Engineering%3A+An+Introduction%2C+10th+Edition-p-9781119405498>

### Grading

- **Weights:** Hour exam 1 **10%**; hour exam 2 **10%**; hour exam 3 **10%**; hour exam 4 (final exam) **10%**; Homework **22%**; In-class participation **3%** (in-class quizzes and polls will be conducted using iClicker with points awarded for participation); Laboratory reports and assignments and quizzes **35%**
- **Scale:** 96 -100 **A+**, 92 -96 **A**, 89 -92 **A-**, 86 -89 **B+**, 82 -86 **B**, 79 -82 **B-**, 76 -79 **C+**, 72 -76 **C**, 69-72 **C-**, 66 -69 **D+**, 62 -66 **D**, 59-62 **D-**, 0 -59 **F**

### Access

- Course materials are communicated through the learning management programs *Canvas* and *Gradescope*. Students may access their individual homework, lab report, and test grades at any time. Classroom lectures will be recorded and made available to students afterwards using the *MediaSpace* system.
- *Gradescope* will be used to submit homework assignments, laboratory reports, written assignments, and worksheets and carry out laboratory quizzes.

## Policies

**Homework assignments** are assigned daily and submitted through the *Gradescope* platform. Assignments are **due at 12:55pm** on each assigned day; late homework (i.e. submitted after that time) will be accepted but a penalty will be applied: 1 point per day late. Solutions will be posted in Newmark building (2nd floor, east end of the south hallway). For full credit, homework must contain the student's name, due date, problem number, *full* problem statement, facsimiles of any provided or required drawings, explanation of solution method using short English phrases, calculations, proper accuracy, correct units, and clearly marked final answer(s). Examples of **good** and **bad** (with respect to format) homework solutions are available.

In-class polls and quizzes will be carried using the *iClicker-cloud* platform, which comprise the in-class participation portion of your grade. Full participation points for a given day are awarded for in-class participation of all polls and quizzes. Both the iClicker wand or your smart phone can be used. More information about setting up your iClicker account can be found [here](#). If you are using a phone for this, be sure to enable geolocation: more information about that can be found [here](#).

**Lab assignments** (lab reports, lab worksheets, writing assignments) are assigned weekly. Reports and writing assignments are to be prepared from scratch by each student individually. The text portion of lab reports must be prepared on a word processor following indicated appropriate formats. Tables and graphs should be done by computer. The date and time that the lab was performed should appear on the cover page. Electronic versions of lab assignments are due **12 hours before** the start of your scheduled lab session, and the submission date and time stamp of submission must reflect this. Submit your final completed assignment using *Gradescope*. Student submitters are responsible for ensuring that a final, complete, non-corrupted file is submitted. Later “improved” versions will not be accepted. Late lab assignments will be accepted, but with a penalty of 10% deduction per day up to 7 calendar days; thereafter, they will not be accepted. To foreground the importance of revision in technical writing, a revision of the very first lab report (Lab 0) is required after it has been graded.

Attendance and participation in your particular scheduled lab sessions is required. **Late arrival to lab (3 minutes after the start of the lab session) will result in loss of the quiz points (see below) for that individual student. Later arrival to lab (i.e. 4-30 minutes after the start of the lab session, at the discretion of the TAs) will furthermore result in loss of 10% from the submissions for that week. Students will not be admitted to lab 30 minutes after the start of the session.** If you miss your lab section for any unexcused reason, you will lose 25% from the day's worksheet; you also must attend another laboratory session that week to receive credit for the worksheet. If necessary, arrangements may be made **at least one week in advance** with the lab instructor to attend a different lab session during the same week.

Quizzes will be given at the beginning of each lab lecture, which are based on the laboratory tests for that week. Lab quizzes will assess your understanding of material for that day's lab. Therefore, you must read the lab manual before arriving at your scheduled lab section or answering the quiz. Lab quizzes cannot be made up if they are missed because of unexcused late arrival or absence.

*Academic integrity* is expected; it is the responsibility of the student to refrain from such infractions as cheating, fabrication, and plagiarism in *any* aspect of the course. The definitions

of, and university policies on, academic integrity are explained in Article 1, Part 4 of the Illinois student code (<http://admin.illinois.edu/policy/code/>). Any assignment where plagiarism or other forms of cheating has been determined to occur will receive a score of zero. Any student who has been determined to plagiarize, cheat or fabricate more than once in this class during the course of the semester will receive a failing grade for the course. All questions of academic integrity will be handled through the established college of engineering procedure (FAIR system), which follows the student code. Please note the Illinois CEE honor code pledge: *I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and 3) always fully contributing to group activities that are part of a course activity.*

*Advanced Composition* aspects of the course are met through the evaluation of scaffolded writing processes across the semester, which place considerable emphasis on technical writing. The laboratory teaching assistants provide feedback to the students through comments on the reports and the grade sheets accompanying each returned report. You may find assistance from **The Writers Workshop** to be helpful. The mission of the Workshop is to support the University of Illinois community by providing free writing assistance for students, and it offers online appointments, in-person appointments, and evening drop-in hours. Find more information at [writersworkshop.illinois.edu](http://writersworkshop.illinois.edu)

## **Safety**

Emergency situations can arise at any moment, so it is best to be prepared for them. Please review the emergency planning information made available by the University Division of Public Safety at <https://police.illinois.edu/emergency-preparedness/run-hide-fight/>

Students who feel ill or are somehow symptomatic of a communicable illness must not come to class. Students who present official documentation of medical treatment (e.g. from the McKinley Health Center or other medical establishment) will be allowed to submit missed work without penalty after the fact.

## **Anti-racism and Inclusivity Statement**

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to Campus Belonging Resources (<https://diversity.illinois.edu/diversity-campus-culture/belonging-resources/>). Based on your report, Members of the Office of the Vice Chancellor for Diversity, Equity & Inclusion staff will follow up and reach out to students to

make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

<i>Date</i>	<i>Topic</i>	<i>Reading</i>	<i>Homework (date due)</i>	<i>Laboratory</i>	<i>Assignment (date due)</i>
<b>Part I - Fundamentals of Materials Behavior</b>					
Jan.15	MLK HOLIDAY (no class)	***	Review homework examples: <u>good</u> and <u>bad</u>	No lab this week	***
Jan.17	<a href="#">Introduction</a>	Chapter 1	***		
Jan.19	<a href="#">Atomic structure and bonding</a>	Chapter 2	***		
Jan.22	<a href="#">Crystalline solids 1</a>	3.1-3.7	<a href="#">Assign. 1</a>	<a href="#">Lab #0: Writing Lab Reports - Part 1</a> 200 Talbot	VR exercise and quiz (10 pts)
Jan.24	<a href="#">Crystalline solids 2</a>	3.8-3.15	<a href="#">Assign. 2</a>		
Jan.26	<a href="#">Imperfections</a>	4.1-4.3,4.5,4.6	<a href="#">Assign. 3</a>		
Jan.29	<a href="#">Diffusion</a>	5.1-5.5	<a href="#">Assign. 4</a>	<a href="#">Lab #0: Writing Lab Reports - Part 2</a> 200 Talbot	Lab Quiz 0_2 (6 pts)  <a href="#">Lab report 0 (draft) (100 pts)</a>
Jan. 31	<a href="#">Dislocations</a>	4.5,7.1-7.6	<a href="#">Assign. 5</a>		
Feb.2	<a href="#">Microstructure</a>	4.9-4.11	<a href="#">Assign. 6</a>		
Feb.5	<a href="#">Phase diagrams 1</a>	9.1-9.8	<a href="#">Assign. 7</a>	<a href="#">Lab #1: The Tension test</a> 200 Talbot	<a href="#">Writing assignment 1 (50 pts)</a>  Lab Quiz 1 (6 pts)
Feb.7	<a href="#">Phase diagrams 2</a>	9.9-9.12	<a href="#">Assign. 8</a>		
Feb.9	<a href="#">Surface physics</a>	<a href="#">Handout 1</a>	<a href="#">Assign. 9</a>		
Feb.12	<a href="#">Surface physics 2</a>	10.1-10.4	<a href="#">Assign. 10</a>	<a href="#">Lab #2: Compression and hardness</a> 200 Talbot	<a href="#">Lab report 0 (revised) (100 pts)</a>  Lab Quiz 2 (6 pts)  <a href="#">Lab 1 worksheet (30 pts)</a>
Feb.14	<a href="#">Exam review</a>	***	<a href="#">Assign. 11</a>		
<b>Feb.16</b>	<b>HOURLY EXAM 1</b>	<b>PART I</b>	***		
<b>Part II - Mechanical Behavior of Materials</b>					
Feb.19	<a href="#">Mechanical properties</a>	6.1-6.10	***	<a href="#">Lab #3: Bending and Torsion</a> 200 Talbot	<a href="#">Writing assignment 2 (30 pts)</a>  Lab 3 Quiz (6 pts)  <a href="#">Lab 2 Worksheet (30 pts)</a>
Feb.21	<a href="#">Strengthening</a>	7.8-7.10,11.4,11.5	<a href="#">Assign. 12</a>		
Feb.23	<a href="#">Strengthening 2</a>	7.11-7.13	<a href="#">Assign. 13</a>		
Feb.26	<a href="#">Fracture</a>	8.1-8.5	<a href="#">Assign. 14</a>		

Feb. 28	<a href="#">Impact and Fatigue</a>	8.6-8.10	<a href="#">Assign. 15</a>	Lab #4: Notch Sensitivity 200 Talbot	<a href="#">Writing assignment 3 (30 pts)</a>
March 1	<a href="#">Creep</a>	8.12-8.14	<a href="#">Assign. 16</a>		Lab 4 Quiz (6 pts) <a href="#">Lab 3 Worksheet (30 pts)</a>
<b>Part III - Engineering Materials</b>					
March 4	<a href="#">Steel 1</a>	9.18-9.20	<a href="#">Assign. 17</a>	Lab #5: Impact and Lab #6: Fracture toughness 200 Talbot	Lab 5/6 Quiz (6 pts)
Mar. 6	<a href="#">Steel 2</a>	11.1,11.2,	<a href="#">Assign. 18</a>		<a href="#">Formal report for Labs 1 and 2 (200 pts)</a>
March 8	<a href="#">Steel 3</a>	10.5	<a href="#">Assign. 19</a>		
March 11	SPRING BREAK – NO CLASS OR LABS				
March 13					
March 15					
March 18	<a href="#">Exam review</a>	***	<a href="#">Assign. 20</a>	Lab #7: Creep of metals and polymers 200 Talbot	Lab 7 Quiz (6 pts)
March 20	<b>HOURLY EXAM 2</b>	<b>Part II</b>	***		<a href="#">Lab 4 Worksheet (30 pts)</a>
March 22	<a href="#">Steel 4</a>	10.6-10.9,11.8,11.9	***		
March 25	<b>NO LECTURE</b>	***	***	Lab #8: Heat treatment of steel 200 Talbot	Lab 8 Quiz (6 pts)
March 27	<a href="#">Ceramics 1</a>	12.1-12.5	<a href="#">Assign. 21</a>		<a href="#">Lab 5/6 Worksheet (30 pts)</a>
March 29	<a href="#">Ceramics 2</a>	12.8-12.11	<a href="#">Assign. 22</a>		<a href="#">Peer review exercise (50 pts)</a>
April 1	<a href="#">Aggregates</a>	<u>Handout 2</u>	<a href="#">Assign. 23</a>	Lab #9: Production of concrete 1225 NCEL	<a href="#">Letter report (Lab 8) (150pts)</a>
April 3	<a href="#">Concrete 1</a>	<u>Handout 3 (A-E)</u>	<a href="#">Assign. 24</a>		<a href="#">Lab 7 Worksheet (30 pts)</a>
April 5	<a href="#">Exam review</a>	***	<a href="#">Assign. 25</a>		Lab 9 Quiz (6 pts)
April 8	<b>HOURLY EXAM 3</b>	<b>Part III through aggregates</b>	***	Lab #10: Testing of concrete 1225 NCEL	<a href="#">Writing assignment 4 (50 pts)</a>
April 10	<a href="#">Concrete 2</a>	<u>Handout 3 (F-J)</u>	***		<a href="#">Writing assignment 5 (10 pts)</a>
April 12	<a href="#">Concrete 3</a>	<u>Handout 3 (K-M)</u>	<a href="#">Assign. 26</a>		Lab 10 Quiz (6 pts)
April 15	<a href="#">Concrete 4</a>	<u>Handout 3 (K-M)</u>	<a href="#">Assign. 27</a>	Lab #11: Testing of wood 200 Talbot	<a href="#">Technical presentation report for Labs 9 and 10 (200 pts)</a>
April 17	<a href="#">Wood 1</a>	<u>Handout 4</u>	<a href="#">Assign. 28</a>		Lab 11 Quiz (6 pts)
April 19	<a href="#">Wood 2</a>	<u>Handout 4</u>	<a href="#">Assign. 29</a>		

April 22	<a href="#">Polymers 1</a>	14.1-14.7	---	Lab #12: Rheology of asphalt cements B226 NCEL	<a href="#">Writing assignment 6 (20 pts)</a> Lab 12 Quiz (6 pts) <a href="#">Lab 11 (30 pts)</a> and <a href="#">Lab 12 (15 pts)</a> worksheets
April 24	<a href="#">Polymers 2</a>	14.11,14.2,15.1-15.5,15.12,15.13	<a href="#">Assign. 30</a>		
April 26	<a href="#">Asphalt</a>	<a href="#">Handout 5</a>	<a href="#">Assign. 31</a>		
April 29	<a href="#">Composites</a>	16.1-16.8,16.14,16.15	<a href="#">Assign. 32</a>	No lab this week	***
May 1	<a href="#">Final exam review</a>	***	<a href="#">Assign. 33</a>		
May 3 (no class)	***				
May 7 8am	<b>Final Exam -- Part III, starting with concrete</b>				