ENGR 4 - Engineering Materials

Fall 2021
Section #53090

Class:
Hybrid (Online and Face-to-Face)
Class meetings on Tuesdays, 1:00-1:50pm, PHY-70
All online class materials posted on Canvas

Instructor:
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Office Hours:
MW 9:00-9:50am
TThF 10:00-10:50am

If you cannot make regular office hours, feel free to make an appointment.

Welcome to ENGR 4, an overview of the science and engineering behind materials! This is a wide-ranging course that will cover the structures, properties, processing techniques, and applications of metals, ceramics, polymers, composites and advanced materials. No matter which area of engineering you are pursuing, you will need to understand the materials with which you are working. From this course you will obtain a fundamental understanding of these materials.

Course Communication Policy:
We will see each other during our Tuesday afternoon face-to-face meeting. So, this is a great time for questions. In fact, I will not be using this time for lectures. Instead, you will be usually completing group activities. During this time, I would like you to ask questions so that I can clarify the concepts and problem-solving methods from the class.

For the online portion of the class, my instructions to you will be posted in a weekly module. Be sure to read through all instructions posted in the module so that you fully understand what you need to complete each week. *(Do not simply look at assignments posted in your course calendar. You will miss some important instructions if you do that.)* You will be reading through the interactive textbook and watching my recorded lectures each week. Feel free to contact me via email or Canvas message if you have questions during the week. You do not need to wait until Tuesday to ask questions!! I will reply within 24 hours on weekdays. I may be able to respond on weekends as well, but it is not guaranteed. *(If I do not respond within 24 hours, please resend your message.)*

I also encourage you to communicate with your classmates. Get to know your classmates during our Tuesday sessions and then use them as a resource to help yourself learn!

Prerequisites: CHEM 1A, PHYS 4A

Catalog Description: This is an introductory course on the properties of engineering materials and their relation to the internal structure of materials. Topics include atomic structure and bonding; crystalline structures; phases and phase diagram; metals; polymers; ceramics; composites; mechanical deformation and fracture; structural control and influence of properties; materials naming and designating systems; and electrical properties.

Textbook: Zybook, incorporated within our Canvas course shell: Materials Engineering, with content by Callister, William D. and Rethwisch, David G.
(The first chapter of the textbook is free. You will need to purchase access – for approx.. $40 – to continue through the book.)

The readings from the textbook are interactive. When you are assigned a reading assignment, you must complete the participation and challenge activities. You will receive a grade based on your completion of these tasks.

Grading:	20%	Zybook Assignments
	20%	In-Class and other Class Assignments
	60%	Four Exams

Zybooks Assignments: As previously mentioned, you will be given reading assignments from the Zybooks textbook. While reading each section, you will be asked to complete participation and challenge activities. These will help you to gain understanding on the material. These readings will typically be due each Monday night.

In-Class and Other Assignments: During our face-to-face class meetings, we will work though activities that will help you in your understanding of the concepts and the problem-solving methods for this course. You will begin these assignments in class (and possibly finish them). Generally, they will be due by Thursday night. (You will scan your work and submit your work on Canvas.) If you are absent on the day of one of these assignments, it is your responsibility to download the assignment from Canvas and complete it individually.

There may be other assignments given outside of the class period that will also count for this section of the grading.

Late Work: Late assignments will be accepted but will not receive full credit. Each day that an assignment is late will lead to a 2% deduction.

Four Exams: Four exams are given during the semester. Each exam will cover the most recent chapters. The final exam will be given during exam week and will cover the recent material and cumulative material from the entire semester. Rules for what resources are allowed during these exams will be announced before each exam.

Tentative Test Dates: 9/21, 10/19, 11/16, 12/7

Grading Scale:	90-100%	A
	80-89.9%	B
	70-79.9%	C
	60-69.9%	D
	<60%	F

Accommodations for Students with Disabilities:
If you have a verified need for an academic accommodation or materials in alternate media (i.e., Braille, large print, electronic text, etc.) per the Americans with Disabilities Act (ADA) or Section 504 of the Rehabilitation Act, please contact me as soon as possible.

Add Date:	Friday, August 27	Last day to add a course
Drop Date:	Friday, October 8	Last day to drop this course
Holidays:	Monday, September 6	Labor Day
	Thursday, November 11	Veterans' Day
	Thursday-Friday, November 25-26	Thanksgiving Holiday
Final:	Tuesday, December 7, 1:00-2:50pm	

Student Learning Outcomes:

Upon completion of this course, students will be able to:

1. classify crystal structures and crystal imperfections and determine their effects on material properties.
2. use mechanical behavior data for a given material to predict a material's behavior under a certain load condition.
3. interpret phase diagrams and predict material microstructures created by different heat treatments.
4. identify the properties of the various classes of materials and assess the proper material to be used in certain applications.

Objectives:

In the process of completing this course, students will:

1. define the types of bonds and list their properties.
2. classify the various crystal structures and use crystallographic techniques to describe their features.
3. describe crystalline imperfections and analyze their influence on material behavior.
4. analyze stress-strain curves and calculate materials' reactions to various stress conditions.
5. differentiate elastic and plastic deformation.
6. describe the mechanisms for strengthening materials.
7. calculate failure loads of materials based on fracture and fatigue.
8. calculate materials' reactions under high temperature loading.
9. interpret phase diagrams and solve problems based upon them.
10. use phase diagrams to predict microstructural development in materials under heat treatment.
11. analyze the properties of the various classes of materials.
12. categorize and investigate the variety of materials within each class of materials.
13. outline and apply the electrical and corrosive properties of materials.
14. use reference data regarding the properties, processing, and performance characteristics of materials to recommend appropriate materials to meet engineering design criteria.

Course Schedule: (subject to change) --

	In-Class	Online
Week 1	Overview of Course	Introduction, Atomic Structure, and Bonding
Week 2	Group Activity (Atomic Structure and Bonding)	Crystal Structures of Metals and Ceramics
Week 3	Group Activity (Crystal Structures)	Polymer Structures
Week 4	Group Activity (Polymer Structures)	Imperfections in Solids
Week 5	Group Activity (Imperfections)	Diffusion
Week 6	Group Activity (Diffusion)	Review
Week 7	**Test #1**	Mechanical Properties
Week 8	Group Activity (Mechanical Properties)	Deformation and Strengthening Mechanisms
Week 9	Group Activity (Deformation and Strengthening)	Failure: Fracture, Fatigue, and Creep
Week 10	Group Activity (Failure)	Review
Week 11	**Test #2**	Phase Diagrams
Week 12	Group Activity (Phase Diagrams)	Phase Transformations
Week 13	Group Activity (Phase Transformations)	Electrical Properties
Week 14	Group Activity (Electrical Properties)	Review and Applications/Processing of Metals/Ceramics
Week 15	**Test #3**	Composites
Week 16	Group Activity (Composites)	Corrosion and Degradation of Materials
Week 17	Group Activity (Corrosion)	Review
Week 18	**Final Exam**	