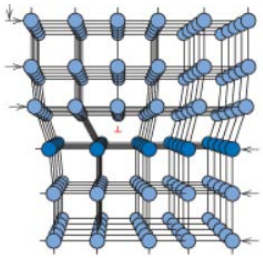

Engineering Materials

ENGR 4

Fall 2018

Section #55103

Instructor: Dr. John Heathcote

Class Times: Tuesdays/Thursdays, 8:00-9:15AM

Classroom: PHY-70

Office: FEM-1B (in the math study center)

Phone: (559) 638-0300 ext. 3215

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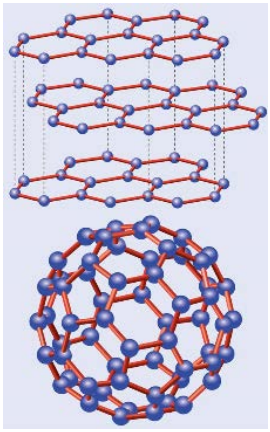
Office Hours: MW, 10:00-11:50AM, F, 11:00-11:50AM

Prerequisites: CHEM 1A, PHYS 4A



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.

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: Callister, William D. and Rethwisch, David G., **Fundamentals of Materials Science and Engineering, An Integrated Approach**, 5th Edition, Wiley, 2015.

Grading:

40%	Quizzes
25%	Reading Assignments and Homework
15%	Midterm Exam
20%	Final Exam

Quizzes: There will be approximately 10 quizzes during the term. Each of these will take about 30 minutes during a class meeting and will cover material from a recent chapter or combination of chapters. These will be preannounced. (A tentative schedule is included in the course schedule.) Topics on these quizzes will include both conceptual ideas as well as computational techniques.

Alternate Quiz Arrangements: If you are unable to take a quiz during the scheduled time, you must contact the instructor before the class period. If you are sick on the day of a quiz, you need to send an email or a

Canvas message to the instructor before class. This will allow you to take a make-up quiz. If I do not hear from you before the quiz, you will not be able to make it up.

Reading Assignments and Homework: For most class periods, you will have two tasks to complete. A homework assignment of calculation problems based upon material covered in the previous class and a reading assignment for the material that will be covered in the next class meeting. The homework assignments will be problems (usually from the textbook) that will be worked out by hand and submitted in class. The reading assignment will be a set of fill-in-the-blank notes that will be completed and submitted on Canvas.

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

Midterm and Final Exam: Two cumulative exams are given during the semester. The midterm will be given in approximately the eighth week and will cover all material up to that point in the semester. The final exam will be given during exam week and will cover material from the entire semester. Rules for what resources are allowed during these exams will be announced before each exam.

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 31	Last day to add a course
Drop Date:	Friday, October 12	Last day to drop this course
Holidays:	Monday, September 3	Labor Day Holiday
	Monday, November 12	Veterans Day Holiday
	Thursday-Friday, November 22-23	Thanksgiving Holiday
Final Exam:	Tuesday, December 11th, 8:00AM – 9:50AM	

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) --

Week	Tuesday	Thursday
1	Chapter 1 - Overview	Chapter 2 – Atomic Structure and bonding
2	Sections 3.1 - 3.10 **–** Crystals, unit cells, density, metallic/ceramic structures	Sections 3.11 - 3.21 – Crystallography **Chap 1,2 Quiz**
3	Sections 4.1-4.5 – Polymer Chemistry	Sections 4.6-4.12 – Polymer molecules and crystallinity **Chap 3 Quiz**
4	Chapter 5 – Defects	Chapter 6 – Diffusion
5	Sections 7.1-7.5 – Elastic Deformation	Sections 7.6-7.9 – Mechanical behavior of metals **Chaps 4-6 Quiz**
6	Sections 7.10-7.20 – Mechanical behavior of ceramics and polymers, Hardness	Sections 8.1-8.8 – Deformation mechanisms in metals **Chap 7 Quiz**
7	Sections 8.9-8.14 – Strengthening Mechanisms, recovery, recrystallization, and grain growth	Sections 8.15-8.19 – Deformation mechanisms of ceramics and polymers **Chap 8 Quiz**
8	**Midterm Review**	**Midterm (Chaps 1-8)**
9	Sections 9.1-9.8 – Fracture and Fracture Toughness	Sections 9.9-9.19 – Fatigue and Creep
10	Sections 10.1-10.8 – Basic phase diagrams	Sections 10.9-10.16 – Microstructure and phase diagrams **Chap 9 Quiz**
11	Sections 10.19-10.21- Iron-Carbon Phase Diagram	Sections 11.1-11.4 – Kinetics of phase transformations **Chap 10 Quiz**
12	Sections 11.5-11.9 – Phase transformations in iron-carbon alloys	Sections 11.10-11.17 - Precipitation hardening and polymer kinetics
13	Sections 12.1-12.9 – Electrical conduction	Sections 12.10-12.17 – Semiconductivity and Semiconductor Devices **Chap 11 Quiz**
14	Sections 12.18-12.25 Dielectric Behavior, Ferroelectricity, and Piezoelectricity	Chapter 13 – Types and applications of materials / **Chap 12 Quiz**
15	Chapter 14 – Processing of Materials	Thanksgiving Holiday
16	Chapter 15 – Composites	Chapter 16 – Corrosion and degradation of materials **Chaps 13-16 Quiz**
17	Chapter 20 – Economic, environmental, and societal issues /	Semester Review
18	Final Exam	