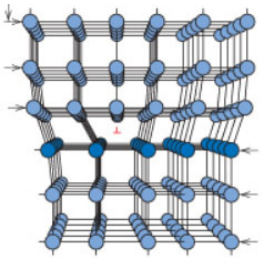
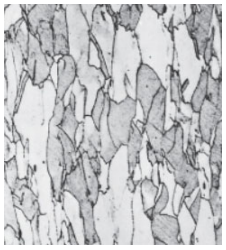


Engineering Materials

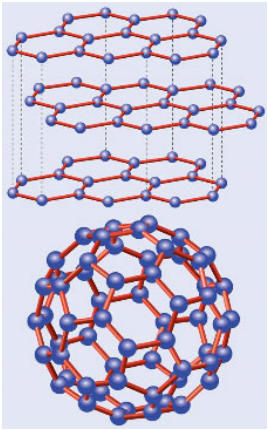
ENGR 4

Fall 2019

Section #52329



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
e-mail: john.heathcote@reedleycollege.edu



Office Hours:

M	9:00-10:30am
T	9:30-10:00am (in PHY-70)
W	9:00-10:30am
Th	9:30-10:00am (inPHY-70)
F	9:00-10:00am

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

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:

20%	Homework
20%	In-Class Assignments
60%	Three Exams

Homework: For each class period, there will be textbook pages to read and a written assignment to complete. These will be reviewed and collected the next class period. It is very important that you complete these assignments to practice the calculations and review the concepts from the lecture. Written work should be neat and show your work to receive full credit.

In-Class Assignments: To review and practice the material, a portion of certain days will involve in-class problem solving. The deadline for these in-class assignments will be announced in class. If you are absent on the day of one of these assignments, it is your responsibility to find the work and make it up.

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.

Three Exams: Three exams are given during the semester. Two midterms will be given and will cover several chapters each. 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.

Tentative Test Dates: 9/10, 10/29, 12/12

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 30	Last day to add a course
Drop Date:	Friday, October 11	Last day to drop this course
Holidays:	Monday, September 2	Labor Day
	Monday, November 11	Veterans' Day
	Thursday-Friday, November 28-29	Thanksgiving Holiday
Final:	Tuesday, December 12, 8:00-9:50 am	

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
3	Sections 4.1-4.5 – Polymer Chemistry	Sections 4.6-4.12 – Polymer molecules and crystallinity
4	Chapter 5 – Defects	Chapters 1-5 Review
5	**Test #1** (Chapters 1-5)	Chapter 6 – Diffusion
6	Sections 7.1-7.5 – Elastic Deformation	Sections 7.6-7.9 – Mechanical behavior of metals
7	Sections 7.10-7.20 – Mechanical behavior of ceramics and polymers, Hardness	Sections 8.1-8.8 – Deformation mechanisms in metals
8	Sections 8.9-8.14 – Strengthening Mechanisms, recovery, recrystallization, and grain growth	Sections 8.15-8.19 – Deformation mechanisms of ceramics and polymers
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
11	Sections 10.19-10.21- Iron-Carbon Phase Diagram	Chapters 6-10 Review
12	**Test #2** (Chapters 6-10)	Sections 11.1-11.4 – Kinetics of phase transformations
13	Sections 11.5-11.9 – Phase transformations in iron-carbon alloys	Sections 11.10-11.17 - Precipitation hardening and polymer kinetics
14	Sections 12.1-12.9 – Electrical conduction	Sections 12.10-12.13 – Semiconductivity
15	Sections 12.15-12.25 – Semiconductor Devices; Capacitance	Thanksgiving Holiday
16	Chapter 15 – Composites	Chapter 16 – Corrosion and degradation of materials
17	Chapter 20 – Economic, environmental, and societal issues /	Semester Review
18		**Final Exam** (Cumulative)