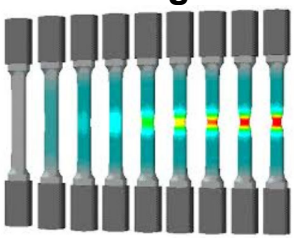
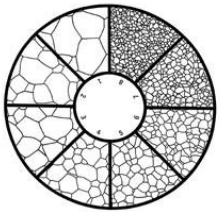
Engineering Materials Laboratory — Fall 2019

Engineering 4L – *Section #52330*





Instructor: Dr. John Heathcote **Lab Times, Location:** Tuesdays, 2:00-4:50pm, PHY-70

Office: Reedley College, FEM-1B (in Math Center, in FEM Building)

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.

Required Text: None (However, the topics of this laboratory course will coincide with the topics covered in ENGR 4 and in its textbook, Callister, William D. and Rethwisch, David G., **Fundamentals of Materials Science and Engineering, An Integrated Approach**, 5th Edition, Wiley, 2015.

Prerequisites: CHEM 1A, PHYS 4A

Catalog Description: This is a laboratory course in which students investigate the structure, properties, and performance of engineering materials, with topics including crystal structures, metallography, cold working and heat treatment, mechanical behavior, ductile and brittle failure, toughness, fatigue, corrosion, and properties of semiconductor devices.

Grading:

70%	Laboratory Exercises and Reports
10%	Presentation on a Topic in Materials Engineering
20%	Final Exam

Laboratory Exercises and Reports: This is a laboratory course, so the major portion of the grade will be based upon the performance of labs and the reports that go along with these labs. Labs need to be performed on the week that they are scheduled. It is important that you are able to write about your experimental work. Because of this, each week you will have a follow-up written assignment. Sometimes, it will involve rather informal answers to questions. Other times, it will be a more formal lab report. This is to help prepare you for lab reports at the university level.

Presentation on a Topic in Materials Engineering: During the semester, you will research a topic in materials engineering and give a presentation to the class. Specific requirements for this presentation and your assigned presentation date will be announced during the semester.

Final Exam: During finals week, a comprehensive final exam will be given. This exam may cover both lab techniques and calculation problems.

Grading Scale:		
	90-100%	A
	80-89%	B
	70-79%	C
	60-69%	D
	<60%	F

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:	**Thursday**, December 12, 2:00-3:50 pm	

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.

Course Outline: (subject to change)

Lab Dates	Topics
Tuesday, August 13th	Atomic Bonding and Metal Crystal Structures
Tuesday, August 20th	Ceramic Crystal Structures
Tuesday, August 27th	Polymer Structures
Tuesday, September 3rd	Structural Imperfections
Tuesday, September 10th	Hardness and Diffusion
Tuesday, September 17th	Tensile Properties of Metals
Tuesday, September 24th	Mechanical Properties of Ceramics
Tuesday, October 1st	Steel Heat Treatments
Tuesday, October 8th	Failure – Fracture and Fatigue
Tuesday, October 15th	Failure - Creep
Tuesday, October 22nd	Phase Diagrams
Tuesday, October 28th	Mechanical Properties of Polymers
Tuesday, November 5th	Iron-Carbon Kinetics
Tuesday, November 12h	Electrical Resistivity / Presentations
Tuesday, November 19th	Semiconductors and Capacitance / Presentations
Tuesday, November 26th	Recycling Plant Tour
Tuesday, December 3rd	Materials Processing / Presentations
Thursday, December 12th	Final Exam

COURSE OUTCOMES:

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

A. operate materials testing equipment and gather and analyze relevant data in order to measure material properties and/or evaluate processing treatments.

B. write laboratory reports that communicate the collection, analysis, and interpretation of experimental data according to professional engineering standards.

COURSE OBJECTIVES:

In the process of completing this course, students will:

A. model various crystal structures found in metals and nonmetals
B. model crystal imperfections and analyze their effect on material properties
C. measure stress-strain behavior for metals, polymers and ceramics
D. investigate ductile and brittle fracture and identify the type of failure from fracture surfaces
E. determine the relative toughness of various materials through impact testing
F. evaluate fatigue behavior of metals
G. analyze equilibrium phase diagrams and predict phases and microstructure present under certain conditions
H. investigate the effect of various materials processing techniques (such as strain hardening, recrystallization, and precipitation hardening) on the structure and properties of metals
I. assess the corrosion resistance of various materials under certain environmental conditions
J. measure the behavior of semiconductor devices

LAB CONTENT:

A. Materials Overview
    1. Classification of Materials
    2. Properties of Materials
    3. Materials Usage
B. Crystal Structures
    1. Modeling
    2. Density and Packing Factor
    3. Crystal Imperfections

C. Mechanical Behavior
    1. Stress Strain Behavior
    2. Elastic vs. Plastic Deformation
    3. Ductile vs. Brittle Fracture
    4. Hardness Testing
    5. Toughness and Impact Testing
    6. Fatigue loading and behavior

D. Phase Diagrams
    1. Interpreting phase diagrams
    2. Experimental determination of phase diagrams
    3. Prediction of phases and microstructures

E. Metallography
    1. Metallurgical Microscopy
    2. Sample Preparation
    3. Grain size measurements and characterization

F. Cold Working and Heat Treatment
    1. Effect of Cold Working on structure and properties
    2. Effect of Heat Treatment on structure and properties
    3. Evaluation of Materials Processing Treatments
        i. Strain Hardening
        ii. Recrystallization
        iii. Precipitation Hardening

G. Corrosion Resistance of various materials

H. Electrical Properties of Materials
    1. Conductivity
    2. Properties of Semiconductor Devices