

ME 254: MATERIALS ENGINEERING
2nd Semester 1435-1436

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Office Hours Sunday, Tuesday, Thursday: 11:00 - 12:00

Course Description

Catalog Data:	ME 254 Materials Engineering 4 (3,1,2)
	Introduction to materials engineering; Atomic bonding; Structure and characteristics of metals; polymers and ceramics; Imperfections; Mechanical properties of metals, polymers, ceramics; Equilibrium-phase diagrams; Microstructures of alloys; Heat treatment of plain-carbon steels, cast irons and precipitation hardening; Annealing; Structural Materials.
Number of Credits:	4
Level:	3
Prerequisite by Course:	CHEM 101, PHYS 104
Prerequisites by Topic:	General Chemistry and Physics.
Textbook:	<i>Materials Science and Engineering - An Introduction, W.D. Callister, John Wiley.</i>
Reference:	Introduction to Materials Science for Engineers, J. F. Shackelford, Prentice Hall.
Laboratory Projects:	<ul style="list-style-type: none"> ▪ Experiment # 1: Sample preparation ▪ Experiment # 2: Revealing microstructure using optical microscopy and scanning electron microscopy ▪ Experiment # 3: Determination of grain size and phase volume fraction ▪ Experiment # 4: Hardness test ▪ Experiment # 5: Tensile test ▪ Experiment # 6: Impact test ▪ Experiment # 7: Cooling curves for different compositions of Pb-Sn alloy ▪ Experiment # 8: Effect of different heat treatments (annealing, quenching, and tempering) on the mechanical properties of low carbon steels ▪ Experiment # 9: Effect of cold rolling on the mechanical properties of Aluminum and Brass sheet
Class/Laboratory Schedule :	Lecture, Tutorial, and Lab.
Laboratory reports	After each lab session, a lab report will be required. (mandatory)
Assessment tools:	Homework + Quizzes ----- 9 % Lab ----- 15% Two mid term exams----- 36% Final exam----- 40%
Date of Preparation	January 24 , 2014

Chapter	Topic Concepts	Duration (lectures)	Sections	Problems
1	Introduction to materials, Materials science and engineering, Classification (metals, ceramics, polymers, composites. Advanced Materials.	(2 classes)	All sections	
2	Structure of atom, bonding and coordination in metals, polymers and ceramics. Effect of atomic bonding on thermal and mechanical properties.	(2 classes)	2.1, 2.2, 2.6, 2.7, 2.8	2.1, 2.18, 2.22, 2.23
3	The Structure of metals (lattices, crystals, crystal directions, planes). Crystalline and non crystalline solids. Indices and densities, polymorphism and allotropy. Metal structures, Structure of Ceramics, Polymeric structure.	(6 classes)	3.1 to 3.15 and 3.17 12.1 to 12.4	3.3, 3.4, 3.8, 3.10, 3.14, 3.16, 3.21, 3.31, 3.32, 3.36, 3.41, 3.45
4	Imperfections in crystalline solids; point, linear and planar defects. Microscopic Examinations.	(4 classes)	All sections	4.2, 4.3, 4.4, 4.7, 4.21
5	Diffusion mechanisms, Steady state diffusion	(2 classes)	5.1 to 5.3	5.1, 5.3, 5.4, 5.7
6, 7	Mechanical properties (elastic and plastic deformation, slip systems and deformation mechanisms). Mechanical testing (tensile, torsion, bending, impact, hardness). Mechanism of Strengthening in Metals, Annealing; recovery, recrystallization and grain growth.	(8 classes)	6.1 to 6.10 7.1 to 7.13	6.4, 6.8, 6.16, 6.21, 6.29, 6.40, 6.45, 6.46, 6.48 7.5, 7.10, 7.11, 7.12, 7.15, 7.20, 7.21
9	Equilibrium-phase diagrams, their construction and types, phase changes, and phase quantities. Relation between phases and properties.	(7 classes)	All sections	9.5, 9.7, 9.23, 9.35, 9.53, 9.54, 9.66
10	Phase transformation in metals		10.5	
11	Applications and Processing of Metal Alloys Ferrous and nonferrous alloys, Thermal processing of metals.	(6 classes)	11.1 to 11.3 and 11.7	
12	Ceramics and Glasses.	(4 classes)	12.1 to 12.4	12.1 to 12.8, 12.12 to 12.17, 12.25 to 12.33, 12.44 to 12.47
14	Polymers	(4 classes)	14.1 to 14.3	14.1 to 14.16, 14.25 to 14.29