ME 254: MATERIALS ENGINEERING
First Semester 1435-1436

Instructor: Dr. Hamad F. Alharbi
Building 3, Room 2C 59
Mechanical Engineering Department, King Saud University
P O Box 800, Riyadh 11421
Tel: +96611 4676660, Fax: +966114676652
Email: harbihf@ksu.edu.sa

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: *Materials Science and Engineering - An Introduction, W.D. Callister, John Wiley.*

Reference: Introduction to Materials Science for Engineers, J. F. Shackelford, Prentice Hall.

Laboratory Projects:
1. Equilibrium-phase diagrams and their construction (Example Sn-Pb system).
2. Metallographic specimen preparation.
3. Quantitative metallography.
4. Microstructures of plain-carbon steel and cast iron.
5. Heat treatment of plain-carbon steel.
6. Tension testing of materials.
7. Impact testing of materials.
8. Hardness testing.

Class/Laboratory Schedule : Lecture, Tutorial, and Lab.

Laboratory reports After each lab session, a lab report will be required. (mandatory)

Assessment tools:
Homework + Quizzes ---------- 5-10%
Lab ---------- 15%
Two mid term exams---------- 40%
Final exam---------- 40%

Date of Preparation August, 30, 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, recryatallization 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 10	Equilibrium-phase diagrams, their construction and types, phase changes, and phase quantities. Relation between phases and properties. Phase transformation in metals	(7 classes)	All sections 10.5	9.5, 9.7, 9.23, 9.35, 9.53, 9.54, 9.66
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