

## Department of Mechanical Engineering

### ME 254 Materials Engineering

**Instructor:** Prof. Dr. Khalil Abdelrazek (2C49)  
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**Office Hours:** Every day from 10:00 to 11:00 AM

### 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 :** Three 50 minutes lectures, one 50-minute recitation and one 100-minutes lab session per week.  
**Laboratory reports Assessment tools:** After each lab session, a lab report will be required. (mandatory)  
Homework----- 9%  
Lab report + Lab exam ----- 15%  
Two mid-term exams----- 36%  
Final exam----- 40%

**Date of Preparation** 12/04/1436

## ME 254: MATERIALS ENGINEERING

Second Semester 1435-1436

Instructors: Prof. Khalil Abdelrazek (2C49)

**TEXTBOOK:** Materials Science and Engineering an Introduction, W. D. Callister, Seventh Edition, Wiley Publishing

Chapter	Topic Concepts	Duration (lectures)	Articles	Homework 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, 6.45, 6.46, 6.48 7.5, 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	9.1, 9.2, 9.3, 9.8, 9.9, 9.10, 9.11, 9.12, 9.15, 9.17, 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