

MECH2410 Engineering Materials I

Course Code: MECH2410	Course Title: Engineering Materials I
Required Course Or Elective Course: Required	Terms Offered (Credits): Spring (3 credits)
Faculty In Charge: Hong Tao & Qingbin Zheng	Pre/Co-Requisites: NA
Course Structure: 3 hour lecture per week, 1 hour tutorial per week, 3 lab hours per semester	
Textbook/Required Material: MATERIALS SCIENCE AND ENGINEERING: AN INTRODUCTION; 9TH EDITION, WILLIAM D. CALLISTER, JR.	
Course Description: Introduce the basic concepts and principles of materials science and engineering. Emphasis will be placed on materials structures (e.g. atomic & crystal structures), the relationship between material microstructure (e.g. grain size, defects) and their properties (e.g. strength & ductility). Special focus will be on the mechanical behavior of ferrous and non-ferrous metals, phase transformation, and the optimization of their mechanical properties through various processing technique and heat treatments.	
Course Topics: <ol style="list-style-type: none">1. Introduction to Material Science<ul style="list-style-type: none">• Historical Perspective, Classification of Engineering Materials, Modern Materials Needs2. Atomic Structure, Atomic Bonding<ul style="list-style-type: none">• Atomic Models, Atomic Bonding in Solid Materials, Product Examples3. Crystal Structure, Basic Crystallography<ul style="list-style-type: none">• Crystal System and Unit Cells, Crystallographic Points, Direction, Planes, Atomic Packing Factors, X-Ray Diffraction Techniques4. Imperfections in Solids<ul style="list-style-type: none">• Point Defects, Dislocations, Surface Defects, Volume Defects5. Mechanical Properties of Materials<ul style="list-style-type: none">• Elastic Properties, Plastic Deformation, Mechanical Testing6. Dislocation and Deformation<ul style="list-style-type: none">• Slip Systems, Slip in Single Crystals, Deformation by Twinning7. Theory of Strengthening of Metals<ul style="list-style-type: none">• Mechanism of Strengthening in Metals, Recovery, Recrystallization, Grain Growth8. Materials Failure<ul style="list-style-type: none">• Introduction to Fracture Mechanics, Fatigue, Creep9. Properties of Metals and Their Fabrication Methods<ul style="list-style-type: none">• Ferrous and Non-Ferrous Alloys, Forming and Casting Processes, Powder Metallurgy, 3-D Printing Process10. Diffusion<ul style="list-style-type: none">• Diffusion Mechanism, Steady State, Non-Steady State Diffusion11. Phase Diagrams<ul style="list-style-type: none">• Binary Alloys and Their Diagrams, Eutectic Alloys, Intermetallic, Complex Binary Systems, Iron-Carbon (Steel) System12. Phase Transformation<ul style="list-style-type: none">• Kinetics of Solid-State Transformation, Time-Temperature Dependence of Transformation, Heat Treatment and Their Effect on Microstructure, Properties of Iron-Carbon (Steel) System13. Corrosion of Metals<ul style="list-style-type: none">• Electrochemical Considerations, Forms of Corrosion, Corrosion Prevention	

Course Objectives:	<ol style="list-style-type: none"> 1. To introduce basic and entry level of materials science and engineering. 2. To equip students ability to identify engineering materials for engineering design and applications. 3. To provide students basic training for materials testing and light microscopy examinations. 								
Course Outcomes:	<ol style="list-style-type: none"> A. Explain basic materials properties and the atomic/microstructure relationship. B. Describe the basic relationship between materials processing and mechanical properties. C. Determine the use and properties of metallic materials for engineering applications. 								
Assessment Tools:	<table border="0"> <tr> <td>Bi-weekly home-work assignments</td> <td style="text-align: right;">20%</td> </tr> <tr> <td>3 lab reports</td> <td style="text-align: right;">10%</td> </tr> <tr> <td>Mid-term examination</td> <td style="text-align: right;">30%</td> </tr> <tr> <td>Final examination</td> <td style="text-align: right;">40%</td> </tr> </table>	Bi-weekly home-work assignments	20%	3 lab reports	10%	Mid-term examination	30%	Final examination	40%
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