# MECH2410 Engineering Materials I

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<tr>
<th>Course Code: MECH2410</th>
<th>Course Title: Engineering Materials I</th>
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<tr>
<td>Required Course Or Elective Course: required</td>
<td>Terms Offered (Credits): Spring (3 credits)</td>
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<td>Faculty In Charge: Xian Chen</td>
<td>Pre/Co-Requisites: MATH 1012 OR MATH 1013 OR MATH 1023</td>
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<td>Exclusion(s): PHYS3040</td>
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<td>Course Structure: 3 hour lecture per week, 1 hour tutorial per week</td>
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<tr>
<td>Textbook/Required Material: MATERIALS SCIENCE AND ENGINEERING: AN INTRODUCTION; 10TH EDITION, WILLIAM D. CALLISTER, JR.</td>
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**Bulletin Course Description:**
Introduce the basic concepts and principles of materials science and engineering. Emphasis will be placed on materials structures (e.g. bonding, 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 and phase diagram.

**Course Topics:**
1. Introduction to material science
   - Historical perspective, Classification of engineering materials, Modern materials needs
2. Atomic Structure, Atomic Bonding
   - Atomic models, Atomic bonding in solid materials, product examples
3. Crystal structure, basic crystallography
   - Crystal system and unit cells, Crystallographic points, direction, planes, atomic packing factors, X-Ray diffraction techniques
4. Mechanical Properties of materials
   - Elastic Properties, Plastic Deformation, Mechanical testing
5. Defects in Crystalline Solids
   - Point defects, Dislocations, Surface Defects, Volume Defects
6. Theory of strengthening of metals
   - Slip, Mechanism of strengthening in metals, Recovery, Recrystallization, and Grain growth
7. Diffusion
   - Diffusion mechanism, Steady state and non-steady state diffusion
8. Phase Diagrams
   - Binary alloys and their diagrams, Eutectic alloys, intermetallics, complex binary systems, Focus on Iron-Carbon (Steel) System

**Course Objectives:**
1. To introduce basic and entry level of materials science and engineering (P-O1, P-O3)
2. To equip the ability of students to identify engineering materials for engineering design and applications. (P-O3)
3. To provide students basic training for mechanical property characterization techniques. (P-O1, P-O3)

**Course Outcomes:**
On successful completion of this course, students are expected to be able to:
A. Explain basic materials properties and the atomic/microstructure
and program outcomes) relationship. (1) (POC1, POC2, POC3, POC4, POC5, POC11)
B. Describe the basic relationship between materials processing and mechanical properties. (2) (POC1, POC2, POC3, POC4, POC5, POC11)
C. Determine the use and properties of metallic materials for engineering applications. (3) (POC1, POC3, POC4, POC5, POC11)

Assessment Tools: (correlated course outcomes)
In-Class quizzes – 15% (A, B, C)
Home-work assignments – 20% (A, B, C)
Mid-term examination – 25% (A, B, C)
Experimental report – 10% (B, C)
Final examination – 25% (A, B, C)
Course activities – 5% (A, B, C)

BEng in Mechanical Engineering (4-year program)
Program Objectives:
P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,
P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,
P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,
P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,
P-O5. Continuously improve through lifelong learning.

Program Outcomes:
POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;
POC2. ability to design and conduct experiments as well as analyze and interpret data;
POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;
POC4. ability to develop specification and to design system, component, or process to meet needs;
POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;
POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;
POC7. ability to communicate effectively;
POC8. ability to function in multi-disciplinary teams and provide leadership;
POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;
POC10. clear understanding of professional and ethical responsibilities;
POC11. recognition of the need for life-long learning and continuing education;
POC12. international outlook with knowledge of contemporary issues.