



Course Code MENG-272	Course Title Materials Science and Engineering	ECTS Credits 6
Department Engineering	Semester Fall, Spring	Prerequisites CHEM-106
Type of Course Required	Field Engineering	Language of Instruction English
Level of Course 1 st Cycle	Year of Study 2 nd	Lecturer(s) Dr Sarris Ernestos
Mode of Delivery Face-to-face	Work Placement N/A	Co-requisites None

Objectives of the Course:

The main objectives of the course are to:

- Study the atomic structure and interatomic bonding in solids.
- Understand the structure of crystalline solids.
- Develop an understanding of the imperfections in solids.
- Introduce the students to the mechanical properties of metals.
- Provide students with the basics of phase diagrams
- Study the principles and properties of ceramics and polymer structures.

Learning Outcomes:

After completion of the course students are expected to:

- Demonstrate knowledge and understanding the atomic structure and interatomic bonding in solids.
- Differentiate the basic elements of crystalline and amorphous solids.
- Describe phenomena using the knowledge obtained from understanding imperfections and mechanical properties of solids.
- Explain single and binary phase diagrams for the creation of new materials for mechanical engineering applications.
- Understand the physical behavior of ceramics and polymers and apply them for mechanical engineering applications.

Course Contents:

- **Atomic structure and interatomic bonding:** Fundamental concepts, electrons and atoms, bonding forces and energies, primary interatomic bonds, secondary bonding (Van der Waals), mixed bonding, material classification.
- **The structure of crystalline solids:** Unit cells, metallic crystal structures, density computations, polymorphism and allotropy, crystallographic directions and planes, single crystals, polycrystalline materials, anisotropy, X-Ray diffraction in crystals.
- **Imperfections in solids:** Vacancies and self-interstitials, impurities of solids,

dislocations-linear defects, interfacial defects, catalysts, bulk & volume defects.

- ***Mechanical properties of metals***: Concept of stress & strain behavior, anelasticity, tensile properties, true stress and true strain, elastic recovery after plastic deformation, compressive-shear-torsional deformation, hardness.
- ***Phase diagrams***: Solubility limits, phases, microstructure, phase equilibria, one component phase diagrams, binary isomorphous systems, interpretation of phase diagrams, binary eutectic systems, equilibrium diagrams having intermediate phases or compounds, Gibbs phase rule.
- ***Structures and properties of ceramics***: Silicate ceramics, imperfections in ceramics, ceramic phase diagrams, brittle fracture in ceramics, mechanisms in plastic deformation.
- ***Polymer Structures***: Polymer molecules, molecular weight-shape-structure-configurations, copolymers, polymer crystallinity, defects in polymers.

Learning Activities and Teaching Methods:

Lectures, in-class examples and exercises

Assessment Methods:

Homework, mid-term exam, final exam

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Callister D. William & Rethwisch G. David	Materials Science and Engineering: An Introduction, 9 th Edition	Wiley	2009	978-1118324578

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Meyers Marc Andre & Chawla Krishan Kumar	Mechanical Behavior of Materials	Cambridge University Press	2009	978-0511455575