



Course Syllabus

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

Course Objectives:

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 be able 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 Content:

- 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 / Readings:

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

Recommended Textbooks / Readings:

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