<table>
<tr><td>Course Title</td><td colspan="5">Introduction to Materials (with Lab)</td></tr>
<tr><td>Course Code</td><td colspan="5">ME107</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">B.Sc (Level 1)</td></tr>
<tr><td>Year/ Semester</td><td colspan="5">1st (Fall)</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">Professor Christodoulos N. Christodoulou</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td>1</td></tr>
<tr><td>Course Purpose</td><td colspan="5">The purpose of the course is to introduce to the students the different kind of materials used by engineers, to give them an overall view of the properties (mechanical, thermal etc) of the materials and how these relate to the atomic, crystal structure and microstructure of the materials</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">1. Identify the different Types of Materials and many engineering materials and their application, Recognise the Structure – Property – Processing Relationship and suggest ways to produce certain materials with specific properties
2. Draw the Structure of an Atom and recognise its potential chemical behaviour (valence electrons, valence etc), Distinguish among Ionic-Covalent-Metallic Bonding, predict and draw the different type of bonding in many materials
3. Draw a Potential Energy Diagram (Energy as a function of interatomic distance) and explain the attractive and repulsive energies/forces acting on the atoms, Distinguish and explain the nature of Gases – Liquids – Solids in terms of bonding types, binding energy and length of bonding and explain the properties of the materials (thermal expansion, melting point, mechanical stiffness, etc) by using Potential Energy Diagrams (Interatomic Spacing, Binding Energy, deep and shallow energy wells)
4. Recognise the Crystal Structure of Materials (Symmetry, 14 Bravais Lattices) and draw them, Calculate the Directional Density, Planar Density, Bulk Density, Packing Factor of any crystalline material, Recognise the types of Defects in crystals and explain the potential effect of such defects in the mechanical properties of the materials and explain Slip Systems in Crystals and the Influence of Crystal Structure in Slip Process related to the mechanical properties of the materials
5. Read Stress-Strain Diagrams (for Ductile and Brittle Materials, Elastic and Plastic Region, Fracture), Obtain critical to the material parameters (Young's Modulus of Elasticity, Yield Strength, Ultimate Strength, fracture stress, elongation, 0.1% proof stress, 0.2% proof stress, etc), Explain the Strain-Hardening Mechanisms, the Characteristics of Cold/Hot Working and how to apply them in materials and explain the Effect of Annealing on the Mechanical</td></tr>
</table>

	Properties of Cold/Hot Worked Metals (Recovery-Recrystallization-Grain Growth) 6. Explain the types of Testing methods and tools used for testing of materials (Stress vs Strain test, Hardness test, Impact test, microscopes, microstructures etc) 7. Explain and comprehend the Homogeneous Nucleation (Critical Nucleus Size, Activation Energy for Solidification) and show how this applies to materials processing, such as solidification and development of the materials microstructure 8. Explain the Strengthening by Solidification (grain size), the Solid Solution Strengthening by Solidification and Solid-State Diffusion, and the Dispersion Strengthening by Solidification and by Phase Transformations, and suggest applications in engineering materials		
Prerequisites	None	Corequisites	None
Course Content	• Introduction to Materials - Types of Materials - Structure – Property – Processing Relationship • Atomic Structure and Bonding - The Structure of the Atom - Ionic-Covalent-Metallic Bonding - Binding Energy and Interatomic Spacing (Potential Energy Diagrams) • Atomic Arrangements - Gases – Liquids - Solids - The Crystal Structure of Materials (Symmetry, 14 Bravais Lattices) - Directional Density, Planar Density, Bulk Density, Packing Factor • Imperfections in Crystals – Slip Systems in Crystals - Defects - Slip Systems in Crystals (Influence of Crystal Structure in Slip Process) • Physical Properties of Materials in Relation to Bonding and Crystal Structures - Potential Energy Well and Properties - Diffusion of Atoms • Mechanical Testing and Properties - Stress-Strain Diagrams (for Ductile and Brittle Materials, Elastic and Plastic Region, Fracture) - Properties Obtained from Stress-Strain Diagrams (Young Modulus of Elasticity, Yield Stress, Proof Stress, Ultimate Stress, Necking, Fracture, Elongation) - Testing • Strain Hardening and Annealing - Strain-Hardening Mechanisms - Characteristics of Cold Working - Effect of Annealing on the Mechanical Properties of Cold Worked Metals (Recovery-Recrystallization-Grain Growth) • Principles of Solidification - Homogeneous Nucleation (Critical Nucleus Size, Activation Energy for		

<table>
<tr><td></td><td>Solidification)
- Heterogeneous Nucleation (Critical Nucleus Size, Activation Energy for Solidification)
• Introduction to Strengthening of Materials and Processing
- Strengthening by Solidification (grain size)
- Solid Solution Strengthening by Solidification and Solid-State Diffusion
- Dispersion Strengthening by Solidification and by Phase Transformations
• Laboratory (1-hour per week): Sample Preparation for Optical Microscopy, Microstructural Observation, Homogeneous and heterogeneous nucleation from supersaturated solutions, Solidification onset (sub-cooling), phase transformation, Enthalpy of solidification.</td></tr>
<tr><td>Teaching Methodology</td><td>Power Point Presentation of Lectures, Questions, Discussion
Explanations with examples, Reviews, Quizzes

• Lectures for learning the theory and fundamentals in materials
• Explaining with specific examples different aspects in materials and solve specific problems
• Demonstration of actual materials (Silicon mono-crystals, poly-crystalline metal alloys etc)
• Frequent short quizzes (more than 8) on previous class lecture in order to enforce the “every day” studying and prepare the students to readily attend the next class lecture
• Tutorials, where the students ask further questions on the lectures for better comprehension
• Frequent reviews and discussions
• Demonstration Laboratories</td></tr>
<tr><td>Bibliography</td><td>Suggested Textbook:
D. R. Askeland & P. P. Phule, “The Science of Engineering Materials”, Fifth Edition, THOMSON Canada Limited, 2006
Reference Books:
W. D. Callister, “Materials Science & Engineering- An Introduction”, Sixth Edition, 2006
J. M. Shackelford, “Introduction to Materials Science for Engineers”, Pearson Prentice Hall, Sixth edition, 2005
Myer Kutz, “Handbook of Materials Selection”, 2002</td></tr>
<tr><td>Assessment</td><td>• Quizzes: 10%
• Mid-term Exam: 20%
• Laboratory Work: 10% (presence is required)
• Final Exam: 60%</td></tr>
<tr><td>Language</td><td>English</td></tr>
</table>