Course unit title:	Materials Engineering (with Lab)
Course unit code:	ME110
Type of course unit:	Compulsory
Level of course unit:	Bachelor (1st Cycle)
Year of study:	1
Semester when the unit is delivered:	2 (Spring)
Number of ECTS credits allocated :	5
Name of lecturer(s):	Professor Christodoulos N. Christodoulou
Learning outcomes of the course unit:	1. Explain and comprehend the Binary Alloy Phase Diagrams of Completely Miscible Systems (Equilibrium and Non-Equilibrium Cooling Curves, Liquidus, Solidus, Phase Fields, Type of Phases, Lever Rule), calculate the %Phase Composition, %Chemical Composition of Each Phase and draw the corresponding microstructures. Know very well the Cu-Ni Alloy System, Binary Alloy Phase Diagrams of Immiscible Systems Containing Three-Phase Reactions (eutectic, eutectoid, peritectic, peritectoid, monotectic), calculate the %Phase Composition, %Chemical Composition of Each Phase and draw the corresponding microstructures 2. Describe the Fe-C Phases and their Mechanical Properties (Ferrite, Austenite, Cementite, Martensite), comprehend the Time-Temperature-Transformation for Eutectoid Steel (TTT Diagrams) and use it in different applications 3. Design a particular Steel or a Stainless Steel, describe how to heat-treat it, what kind of microstructure will develop and what will be its final mechanical properties 4. Explain the different Processing Methods of Advanced Ceramics (Powder metallurgy, milling, die-pressing, Sintering) and the different Classification of Polymers (Thermoplastic, Thermosetting, Elastomers) and their engineering applications 5. Describe the different types of Composite Materials (Particulate, Fiber and Laminar Composites), their processing and suggest different composites for different engineering applications 6. Explain the fundamentals of Corrosion (Chemical Corrosion, Electrochemical Corrosion, Oxidation) and use the existing methods to prevent it 7. Use non-destructive Testing Methods, identify proper instrumentation and apply them to different engineering materials 8. Use thermocouples to measure temperature profiles and optical microscopy to observe microstructures
Mode of delivery:	Face-to-face
Prerequisites:	ME107 | Co-requisites: None
Recommended optional program components:	None
Course contents:	• Principles of Phase Diagrams and Relationship to Materials Strengthening - Binary Alloy Phase Diagrams of Completely Miscible Systems (Equilibrium and Non-Equilibrium Cooling Curves, Liquidus, Solidus, Phase Fields, Type of Phases, Lever Rule, %Phase Composition, %Composition of Each Phase, Solid Solution Microstructure). Focus on the Cu-Ni Alloy System. - Binary Alloy Phase Diagrams of Immiscible Systems Containing Three-Phase Reactions (eutectic, eutectoid, peritectic, peritectoid, monotectic). • The Iron-Carbon Phase Diagram – TTT Diagrams – Steels and Stainless Steels

	- Fe-C Phases and their Mechanical Properties (Ferrite, Austenite, Cementite, Martensite) - Time-Temperature-Transformation for Eutectoid Steel (TTT Diagrams) - Steel Design and Properties – Compositions – Heat Treatments – Stainless Steels • Ceramics - The Structure of Crystalline Ceramics - Processing of Advanced Ceramics (Sintering) • Polymers - Classification of Polymers (Thermoplastic, Thermosetting, Elastomers) - Polymer Additives – Forming of Polymers • Composites - Introduction (Particulate, Fiber and Laminar Composites) - Dispersion-Strengthened Composites - Examples and Applications of Laminar Composites • Deterioration and Failure of Metals - Corrosion (Chemical Corrosion, Electrochemical Corrosion, Oxidation) - Protection Against Corrosion - Non-destructive Testing Methods **Laboratory (1-hour per week): DTA:** Cooling Curves: Experimental determination of cooling curves for a specific alloy (Pd-Sn) indicating the primary solidification fields and eutectic temperatures. Determination of a Phase Diagram and expected to produce a report
Recommended and/or required reading:	Lecture Notes (power point presentation) given to students through e-learning
Textbooks:	D. R. Askeland & P. P. Phule, “The Science of Engineering Materials”, Fifth Edition, THOMSON Canada Limited, 2006
References:	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
Planned learning activities and teaching methods:	➢ Lectures for learning the theory and fundamentals in materials engineering ➢ Explaining with specific examples different aspects in materials engineering (phase diagrams etc) and solve specific problems ➢ Demonstration of actual materials (Silicon mono-crystals, poly-crystalline metal alloys etc) ➢ Performing demonstration laboratories explaining the use of thermocouples to measure temperature profiles and optical microscopy for observing microstructures ➢ Frequent short quizzes (about 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
Assessment methods and criteria:	• Quizzes: 10% • Mid-term Exam: 20% • Laboratory Work: 10%

	• Final Exam: 60%
Language of instruction:	English
Work placement(s):	No