Course unit title:	**Nanotechnology Applications**				
Course unit code:	AEEE465				
Type of course unit:	Technical Elective				
Level of course unit:	Bachelor (1st Cycle)				
Year of study:	4th				
Semester when the unit is delivered:	Fall or Spring				
Number of ECTS credits allocated :	6	Lectures:	3	Labs:	0
Name of lecturer(s):	Dr Symeon Nikolaou				
Aim of the Course	The aim of the course is to familiarize students with the concepts of the emerging nanotechnologies with emphasis on the current engineering applications. Starting from the basic physical principles presented in undergraduate level mathematics terms, the course intends to provide in depth understanding of the methods used for composition and characterization of basic nanomaterials. In addition, students are provided with the knowledge to comprehend the operation principles and assess the advantages of novel nanodevices and their applications on a variety of topics in the field of Electrical Engineering.				
Learning outcomes of the course unit:	• Gain in-depth knowledge and understanding of the physical principles behind nanomaterials and nano-scale fabrication. • Explain the advantages and compare different types of nanostructures. • Comprehend the technological limitations in fabrication and characterization of nanostructures. • Recognize the potential of exploiting nanothechnology in a traditional fields of engineering. • Discuss the properties and advantages of electronic, magnetic and photonic nanodevices. • Apply nanotechnology for sustainability: energy conversion, storage . solar energy harvesting, or high energy density batteries and nanosensors.				
Mode of delivery:	Face-to-face				
Prerequisites:	None	Co-requisites:	None		
Course contents:	1. **Introduction** -What is nano? -Why nano?				

	-Nanomaterials 2.**Physics Background - Quantum mechanics and statistical physics** - de Broglie's hypothesis - Heisenberg uncertainty principle - Pauli exclusion principle - Schrödinger's equation - Properties of the wave function - Application: quantum well, wire, dot - Structure and bonding - Application: carbon nanotube - Electronic band structure - Electron statistics - Application: Optical transitions in solids 3.**Types of Nanomaterials** -Carbon Nano Tubes - Carbon Nanofibers -Nanoparticles and nanopowders -Nanopowder dispersions 4**. Nanomaterials: Fabrication** - Bottom-up vs. top-down - Epitaxial growth - Self-assembly 5.**Nanomaterials: Characterization** - Structural: XRD, TEM, SEM, STM, AFM - Chemical - Optical - Transport 6. **Electronic Nanodevices** - Background - Quantization of resistance - Single-electron transistors - Esaki and resonant tunneling diodes 7. **Magnetic Nanodevices** -Magnetoresistance -Spintronics 8. **MEMS and NEMS** - Fabrication - Modeling - Applications 9. **Nanotechnology Applications** - Nanotechnology for PVs - Nanotechnology for Sustainability: environment, water, food, and climate - Nanotechnology for Sustainability: energy conversion, storage, and

	conservation - Applications: nanobiosystems, medicine, and health -Applications: nanoelectronics and nanomagnetics -Applications: photonics and plasmonics -Applications: nanostructured catalysts -Applications: high-performance nanomaterials and other emerging areas -Applications: solar energy harvesting, high energy density batteries, high-sensitivity sensors, nanomaterials in catalysis
Recommended and/or required reading:	
Textbooks:	Ghuzang G. Cao, "*Naostructures and Nanomaterials: Synthesis, properties and applications",* Imperial College Press, 2004
References:	- J. Stohr, H.C. Siegmann. Magnetism from Fundamentals to Nanoscale Dynamics. ISBN: 139-783540302827 - A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998 - M.J.Jackson, "Micro fabrication and Nanomanufacturing", CRC press.2005 -A.R.Jha, "MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications", CRC Press 2008 An extensive reading list of relevant academic research papers.
Planned learning activities and teaching methods:	Students are taught the course through lectures (3 hours per week) by means of PowerPoint presentation slides. Lecture notes and presentations are available through the web for students to use in combination with the textbooks. Homework and project assignments are used to develop analytic and qualitative skills related to the course material. Further literature search is encouraged by assigning students to identify and present a specific problem/ applied technology in the field of nanatechnology, gather relevant scientific information about how the problem has been addressed, and eventually present this information in written and orally.
Assessment methods and criteria:	• Assignments 10% • Tests: 30% • Final Exam 60%
Language of instruction:	English
Work placement(s):	No