AEEE465 - Nanotechnology Applications

Course Title	Nanotechnology Applications				
Course Code	AEEE465				
Course Type	Technical Elective				
Level	BSc (1st Cycle) – RES&SES				
Year / Semester	4th / Fall				
Teacher's Name	Assistant Prof Symeon Nikolaou				
ECTS	6	Lectures / week	3	Laboratories/week	0
Course Purpose	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	By the end of the course, students must be able to: • 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.				
Prerequisites	AEEE312	Corequisites	None		
Course Content	. 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
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Topic notes are compiled by students, during the lecture can also be downloaded from the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in

	solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours
Bibliography	**(a) Textbooks:** • A. Ghuzang G. Cao, "Naostructures and Nanomaterials: Synthesis, properties and applications", Imperial College Press, 2004 **(b) 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
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60% respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, quizzes. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments/Quizzes 20% • Mid-Term written exams 80% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 20%, 60% and 20%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**