Course unit title:	Alternative Sources of Energy (with Lab)		
Course unit code:	ME407		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	4		
Semester when the unit is delivered:	7 (Fall)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Professor Christodoulos N. Christodoulou		
Learning outcomes of the course unit:	1. Have a broad knowledge of the different Types of Energy Sources, Describe and analyse typical examples of different Energy Sources 2. Explain how oil and NG are produced, the uses of each fuel and the corresponding applications, Distinguish between CNG and LNG and between LNG and LPG and their advantages 3. Distinguish between Nuclear Fission and Fusion and comprehend the possible environmental effects and potential safety risks involved 4. Make useful thermodynamic calculations in burning fuels (enthalpy of reactions, calorific value, adiabatic temperature flame) 5. Explain Solar energy and applications, Solar central receivers (Parabolic trough, Power towers, Solar Dish generator), Solar Collectors (Flat plate collectors, Vacuum flat plate collectors, Vacuum tube collectors, Compound parabolic concentrators), Solar collector performance, Wind power, Hydro-electric power, Tidal and wave energy 6. Describe how Weather station data analysis (solar radiation, wind velocity/direction, temperature, pressure, humidity, rain, etc) in relation to RES can be done 7. Explain the importance of the hydrogen economy, how Hydrogen is produced in combination with RES, hydrogen storage and distribution 8. Explain how H_2/Fuel Cells operate the potential application of H_2/Fuel Cells (Electric Automobiles)		
Mode of delivery:	Face-to-face		
Prerequisites:	None	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	• Types of Energies (Conventional, Non-Conventional (Nuclear Energy), Renewable Energy Sources & Hydrogen) • Global, European, Cyprus energy balance, systems and distribution • Oil, Natural Gas, CNG, LNG, LPG, Hydrogen characteristics • Fossil fuel reserves • Green-house gases-effect, Global warming • Chemical Thermodynamics (Enthalpy of reaction, Calorific value, Adiabatic flame temperature) • Introduction to the Energy problem and the renewable energy sources • RES-Targets for Europe and Cyprus • Fundamental characteristics and properties of the Renewable Energy Sources. • Solar energy and applications – Solar central receivers (Parabolic trough, Power towers, Solar Dish generator) – Solar Collectors (Flat plate collectors, Vacuum flat plate collectors, Vacuum tube collectors, Compound parabolic concentrators) – Solar collector performance		

	• Wind power • Hydro-electric power • Tidal and wave energy • Hydrogen production/storage from renewable energy sources and H_2 / fuel cells • **Laboratory Work (1-hour per week):** Weather conditions in relation to RES and "Green" Hydrogen Production, Storage and "Green" electricity production: The students will operate a model/system composed of a Photovoltaic, a PEM Water Electrolysis, a Hydrogen Storage, a PEM Fuel Cell and a motor, in order to understand the whole "clean" cycle of storing Solar Energy in the form of "green" hydrogen, which can then be used for on-demand "green" electricity production. They will also learn how to obtain and analyze information from weather stations and perform data analysis (solar radiation, wind velocity/direction, temperature, pressure, humidity, rain, etc) in relation to Renewable Energy Sources (RES), and produce a relative report.
Recommended and/or required reading:	Lecture Notes (power point presentation) given to students through e-learning
Textbooks:	Hydrogen-based Autonomous Power Systems, N. Lymberopoulos and E. Zoulias, Springer, 2008 Renewable Energy by Godfrey Boyle. Oxford University Press February 2004 Renewable Energy Resources by John Twidell, Tony Weir. Spon Press June 2005.
References:	Wind Energy Explained: Theory, Design and Application by J.F Manwell, et al. John Wiley and Sons Ltd April 19, 2002 Energy Systems and Sustainability by Godfrey Boyle et. Al. Oxford University Press. September 2003. Tomorrows Energy: Hydrogen, Fuel Cells and the Prospects for a Cleaner Planet by Peter Hoffman. The MIT Press October, 2002 Powering the Future: The Ballard Fuel Cell and the Race to Change the World by T. Koppel. John Wiley and Sons May, 2001
Planned learning activities and teaching methods:	➢ Lectures for learning the theory and fundamentals in energy ➢ Explaining with specific examples different aspects in energy sources and solve specific problems ➢ Actual demonstration of different RES Technologies such as, Solar production of Hydrogen and electricity production with H_2/Fuel Cells ➢ Frequent short quizzes (about 6) 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: 8% • Mid-term Exam: 16% • Laboratory Work: 16% • Final Exam: 60%
Language of instruction:	English
Work placement(s):	No