AEEE260 - Introduction to Renewable Energy Systems

Course Title	Introduction to Renewable Energy Systems				
Course Code	AEEE260				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	3 / 1				
Teacher's Name	Dr Antonis Papadakis				
ECTS	6	Lectures / week	3	Laboratories / week	
Course Purpose and Objectives	The aim of the course is to familiarize students with the concepts and the principles underlying the field Renewable Energy Sources, to provide students with deep knowledge of the theories and methodologies related to the properties of fuel cells and the principles of hydrogen production and wave power generation and to enable students develop the skills required for the design of renewable energy Systems.				
Learning Outcomes	By the end of the course, students must be able to: 1. Explain the basic concepts behind fuel cells. 2. Define the principles of hydrogen production. 3. Explain wind power technology. 4. Describe biomass and biofuel processes. 5. Explain the principles and fundamentals of photovoltaic generation. 6. Examine the basic concepts of wave power generation. 7. Understand the basic concepts of geothermal energy.				
Prerequisites	None	Required	None		
Course Content	• **Photovoltaics Generation:** Introduction to Photovoltaic generation, The silicon p–n junction, Photon absorption at the junction, Solar radiation absorption, Maximising cell efficiency, Solar cell construction, Types and adaptations of photovoltaics, Photovoltaic circuit properties, Applications and systems, Social and environmental aspects. • **Wind Power:** Introduction to wind power, Turbine types and terms, Linear momentum and basic theory, Dynamic matching, Blade element theory, Characteristics of the wind, Power extraction by a turbine, Electricity generation, Mechanical power, Social and environmental considerations. • **Biomass and Biofuels:** Introduction to Biomass and Biofuels, Biofuel classification, Biomass production for energy farming, Direct combustion for heat, Pyrolysis (destructive distillation), Further thermochemical processes, Alcoholic fermentation, Anaerobic digestion for biogas, Wastes and residues, Vegetable oils and biodiesel, Social and environmental aspects				

	• **Geothermal energy:** Introduction to Geothermal Energy, Geophysics, Dry rock and hot aquifer analysis, Harnessing Geothermal Resources • **Wave Power:** Introduction to Wave power, Wave motion, Wave energy and power, Wave patterns, Devices. • **Fuel Cells:** Introduction to fuel cells, Electrochemical Cells, Fuel Cell Classification, Temperature of Operation, State of the Electrolyte, Type of Fuel, Chemical Nature of the Electrolyte, Fuel Cell Reactions, Alkaline Electrolytes, Acid Electrolytes, Molten Carbonate Electrolytes, Ceramic Electrolytes, Methanol Fuel Cells. • **Hydrogen Production:** Chemical Production of Hydrogen, Historical, Modern Production: a) Partial Oxidation, b) Steam Reforming, c) Thermal Decomposition, d) Syngas, e) Shift Reaction, f) Methanation, g) Methanol, h) Sycrude, Hydrogen Purification, Desulfurization, CO_2 Removal, CO Removal and Hydrogen Extraction, Hydrogen Production Plants, Compact Fuel Processors, Electrolytic Hydrogen, Introduction to Electrolyzer Configurations: a)Liquid Electrolyte Electrolyzers, b) Solid Polymer Electrolyte Electrolyzers, c) Ceramic Electrolyte Electrolyzers, Efficiency of Electrolyzes, Concentration Differential Electrolyzers, Electrolytic Hydrogen Compressors
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. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or 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. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally.
Bibliography	**Textbook** • 3rd Edition, Fundamentals of Renewable Energy Processes, Aldo V. da Rosa, 2012, Elsevier Academic Press, ISBN: 0123972191/9780123972194 **References** • Renewable Energy Resources, 3rd Edition, John Twidell and Tony Wier, Taylor & Francis, 2018, ISBN: 0419253300/9780419253303. • 5h Edition, Renewable Energy, Bent Sørensen, 3rd Edition, Academic Press, 2017, ISBN: 0123750253/9780123750259. • 2nd Edition, Renewable and Efficient Electric Power Systems, Gilbert M. Masters, John Wiley & Sons, 2013, ISBN: 1118140621/9781118140628.

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, oral exam, quizzes, design assignments, design projects and laboratory experiments. 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 10% • Homework 10% • Mid-Term written exams 40% • Project 30% • Quizzes 10% 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 30%, 40% and 30%, 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