Course Title	Conventional Fuels and Renewable Energy Resources (with Lab) (Specialization in Oil & Gas Engineering)				
Course Code	OG407				
Course Type	Compulsory				
Level	B.Sc (Level 1)				
Year/ Semester	4rth / 7th Semester (Spring)				
Teacher's Name	Prof. Christodoulos N. Christodoulou				
ECTS	6	Lectures / week	3	Laboratories/week	1
Course Purpose	The aim of this course is to learn about the existing conventional fuels (Oil, Coal, NG, CNG, LNG, LPG), and to introduce the students into the area of Renewable Energy Sources (RES), such as Solar, Wind, Hydro, Geothermal and other. The students will learn to calculate useful quantities such as Lower Calorific Values and Adiabatic Flame Temperatures of any fuel or fuel mixture under consideration, under stoichiometric Oxygen, stoichiometric air and under any excess of air. Furthermore, they will learn to do calculation related to Carbon Dioxide emissions per kg of fuel and or per kWh electric energy produced in power plans. The students will also have the opportunity to learn and get involved into new energy area such as Hydrogen and H_2/Fuel Cells.				
Learning Outcomes	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, Coal 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. Explan how to calculate the calorific value (kJ/mole, kJ/Nm^3, kJ/kg) and Adiabatic Flame of any mixture of fuels including Natural Gas 6. 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 7. Describe how Weather station data analysis (solar radiation, wind velocity/direction, temperature, pressure, humidity, rain, etc) in relation to RES can be done				

	8. Explain the importance of the hydrogen economy, how Hydrogen is produced in combination with RES, hydrogen storage and distribution 9. Explain how H_2/Fuel Cells operate the potential application of H_2/Fuel Cells (Electric Automobiles) 10. Perform viscosity measurements on crude oil		
Prerequisites	None	Corequisites	None
Course Content	• 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):** Viscosity measurements on Crude Oil. “Green” Hydrogen Production, Storage and “Green” electricity production, Determination of the Watt peak of a PV Module, Weather data collection and determination of the Efficiency of a PV ParkThe 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 (or RES) 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, barometric pressure, humidity, rain, etc) in relation to Renewable Energy Sources (RES), calculate the efficiency of a PV Park, and produce a relative report. Student will be encouranged to pay a visit to a PV Park close-by, have a direct exposure and learn about the design, construction and operation parameters of such a PV Park.
Teaching Methodology	Power Point Presentation of Lectures, Questions, Discussion Explanations with examples, Reviews, Quizzes • Lectures for learning the theory and fundamentals in energy and Chemical Thermodynamics • 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 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
Bibliography	**Suggested Textbooks:** D.M.Himmelblau and J.B. Riggs, "Basic Principles and Calculations in Chemical Engineering" Prentice Hall, 8th Edition Hydrogen-based Autonomous Power Systems, N. Lymberopoulos and E. Zoulias, Springer, 2008 **Reference Books:** Renewable Energy by Godfrey Boyle. Oxford University Press February 2004 Renewable Energy Resources by John Twidell, Tony Weir. Spon Press June 2005. 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
Assessment	• Quizzes: 8% • Mid-term Exam: 16% • Laboratory Work: 16% (presence is required) • Final Exam: 60%
Language	English