AEEE461 - Renewable Energy Sources Instrumentation And Measurements

<table>
<tr><td>Course Title</td><td colspan="5">Renewable Energy Sources Instrumentation And Measurements</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE461</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">4 / 1</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Assoc. Prof. Antonis Papadakis</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>1</td><td>Laboratories / week</td><td>2</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The aim of the course is to familiarize students with the basic mechanical and electrical measurement and instrumentation concepts and principles, to provide students with deep knowledge to perform instrument measurements, calibration and linearization and to enable students develop the skills required to analyse the operational parameters of a solar module and a wind turbine.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
Describe the basic mechanical and electrical measurement and instrumentation concepts
Apply independent judgment in performing instrument measurements, calibration and linearization
Analyze the working principles, operation and applications of various sensors and transducers in relation to renewable energy systems
Identify the components and operational parameters of a solar module
Identify the components and operational parameters of a wind turbine
Experiment with basic concepts of power measurements, calculations and transmission practices
Use of diagnosing and testing equipment for performance assessment</td></tr>
<tr><td>Prerequisites</td><td colspan="2">AEEE360, AEEE362</td><td colspan="2">Required</td><td>AEEE460</td></tr>
<tr><td>Course Content</td><td colspan="5">Introduction to Instrumentation and Measurements: Principles of Instrumentation and Measurements, Errors in Measurements, Measurement Standards, Uncertainties.
Measuring Devices (Sensors and Transducers): Introduction to Sensors and Transducers used in for renewable energy parameter measurements such as solar radiation, wind , Basic Electrical Sensing Elements, Strain Measurement, Introduction to Calibration, Calibration Techniques.
Energy Fundamentals and Trainer Familiarization: identify sources of energy. Review definitions of power and work, measurement methods and units. Identify Trainer components. Highlight safety practices. Perform Lockout-Tagout procedure for proper shut down of machinery.</td></tr>
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	4. Investigation of solar module: Carry out experiments on a solar module and measure its efficiency and long-term performance. Design different configurations of solar collector systems and record their characteristics for variations on temperature, irradiance and angle of incidence. Effect of shading on solar panel operation. 5. Analysis of solar module parameters: determination of cell distribution on a solar panel. Produce experimentally the V-I and P-V curve. Investigate PV array ratings. Setup of an off-grid power system with rechargeable solar cells. Perform and compare series and parallel configurations of circuits for solar cells. 6. Investigation of wind module: calculate and measure the performance of the wind turbine electrical systems. Operate the generator at varying wind force levels. Compare the efficiency for constant-speed and variable-speed configurations. 7. Power management: Perform power measurements and calculate power consumption, Calculate power efficiency and identify power losses. Configure power transmission and distribution systems. 8. DC to AC inverter: Study the main parameters that are involved during the DC-AC conversion, Operate and integrate the inverter in stand-alone systems. Investigate inverter's efficiency. Utilize inverter electrical ratings and specifications. 9. On/Off Grid Operation: learn how to configure stand-alone off-grid systems, battery-based grid-tied systems and grid-tied systems without battery. Perform net metering and dual metering practices. 10. Fault finding and troubleshooting: Follow Systematic troubleshooting steps, perform visual inspections, test mechanical and electrical components. Diagnose common malfunctions with solar panels, wind turbines and inverters. Identify and repair defective parts 11. Field trip to solar park: field trip to an advanced solar park to view the application of large scale solar collectors. The field trip is followed by a written report. 12. Field trip to wind turbine park: field trip to an advanced wind energy park to view the application of large scale wind turbines. The field trip is followed by a written report. 13. Observe a real time installation: Monitor the installation of either a solar or a wind energy system. Write a report on the process and practical aspects to be taken in consideration in an actual application.
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. Laboratory experiments are carried out in small groups and lab reports are required two weeks after the laboratory class resulting in a cumulative mark.
Bibliography	**Textbook** • Laboratory manual **References** • Roger A. Messenger, Jerry Ventre, "Photovoltaic Systems Engineering", Taylor & Francis Group, 2017, 4 ed, 2017. • Fang Lin Luo, Ye Hong, "Renewable Energy Systems: Advanced Conversion Technologies and Applications" CRC Press, ISBN 9781439891094
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% • Design 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