AEEE462 - Smart Grids and Control

Course Title	Smart Grids and Control				
Course Code	AEEE462				
Course Type	Technical Elective				
Level	BSc (Level 1)				
Year / Semester	4th				
Teacher's Name	Assoc. Prof. Marios Lestas				
ECTS	6	Lectures / week	3	Laboratories/week	0
Course Purpose	The aim of the course is to introduce the basic concepts of various components of the smart grid and their impact on the energy industry. The primary objective is to learn the challenges facing the energy industry with respect to power systems and the smart grid and appreciate how control and optimization methods can be used to address these challenges. The course will start with basic principles of power systems, optimization and control methods and will cover topics such as renewable integration, demand side management and response, generation and distribution automation and advanced metering infrastructures.				
Learning Outcomes	By the end of the course, students must be able to: 6. Identify the main components of the smart grid and their principle of operation. 7. Appreciate challenges of the energy industry posed by the introduction of technologies such as renewable energy sources and electric vehicles. 8. Formulate control and optimization problems within the smart grid and utilize classical control and optimization methods to solve these problems. 9. Explain and apply the essential concepts and design principles of smart grid networks. 10. Describe the concepts and issues involved in developing, maintaining and managing a smart grid. 11. Describe advanced metering infrastructures and appreciate the challenges of data collection and handling with respect to theft and cybersecurity. 12. Use appropriate methods to pursue research or other detailed investigation of technical issues consistent with their level of knowledge and understanding.				
Prerequisites	AEEE345		Corequisites	None	

Course Content	**Introduction to Power Systems:** Load and Generation, Distribution Systems, Transmission Lines, Power System Analysis **Introduction to Optimization and Control Methods**: Basic Principles of Feedback Systems, Linear and Non-Linear Programming, Pricing Theory **Demand Side Management and Response:** Definition, Application, State of the Art, Pricing and Energy Consumption Scheduling, Advanced Metering Infrastructures, Electric Vehicles and Vehicle-to-Grid Systems **Generation and Distribution Automation:** Frequency Control, Voltage Control, Reactive Power Control. **Integration of Renewable Sources in the Smart Grid:** Power Electronics, Phase Locked Loops, Microgrids.
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. Where appropriate, taught material as well as examples and design problems are drawn from the recent research activities of the lecturer or other faculty members.
Bibliography	**(v) <u>Textbooks:</u>** • James Momoh, **Smart Grid: Fundamentals of Design and Analysis**, Wiley-IEEE Press, 1st Ed., 2012 ISBN: 978-0470889398. • **<u>References:</u>** • Ali Keyhani, **Design of Smart Power Grid Renewable Energy Systems**, Wiley-IEEE Press, 1st Ed., 2011, ISBN: 978-0470627617. • G.F. Franklin, J.P. Powell and M. L. Workman , ***Digital Control of Dynamic Systems***, Pearson Prentice Hall, 3rd Edition, 1997.
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 and

	design projects. 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 20% • Quizzes 20% 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**