Course Title	Electrical Integration of Renewable Technologies				
Course Code	ECE455				
Course Type	Elective				
Level	Bachelor (1st Cycle)				
Year / Semester	4th Year / 8th Semester				
Teacher's Name	TBA				
ECTS	6	Lectures / week	3 hours / 14 weeks	Laboratories / week	N/A
Course Purpose and Objectives	The objective of this course is to present the methods applied for the integration of electricity produced from renewable energy source (RES) technologies into electrical power systems and networks. Specifically, the course provides the technical details of existing power systems and of the perspective of integrating electrical energy produced from renewable source generators.				
Learning Outcomes	Upon successful completion of this course, students should be able to: • Define the key characteristics of renewable energy source generation and the grid-integration impact on power utilities • Explain the dispatchability, variability, predictability and interconnection issues associated with electricity production of the main renewable technologies • Categorise how renewable technologies impact power system operation and evaluate the effect on the quality of distributed electricity (power quality, waveform and harmonics) • identify the key technical and operational issues related to the high penetration of renewable technologies and distributed generation				
Prerequisites	ECE320	Co-requisites	None		
Course Content	Introduction: Introduction to alternative sources of energy. Renewable and conventional sources of energy. Overview of stand-alone and grid-connected generators. Penetration of renewable energy sources. Electricity consumption. Energy efficiency. Structure of electrical power system. Generation characteristics. Renewable energy economics. Integration of RES. Centralised and de-centralised electricity generation. European target. Integration of RES Technologies: AC power systems. Active, reactive and apparent power. The Per-unit notation. Conservation of power. Transient conditions. Transmission line transfer of power. Principles of power injection. Integration of multiple technologies. Operation of Power Systems:				

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<tr><td></td><td>Operation of power systems. Power plant generation costs. Cycling and reserve costs. Energy discarding. Penetration levels of renewable source technologies. Hydro-electric power plants. Wind power plants. Thermal-solar power plants. Photovoltaic power plants. Storage systems.

Power Electronics:
Power electronic devices. Rectifier. Thyristor and transitor bridge. Harmonics and power quality. DC-DC converters. Converter control systems. Grid-connected inverters for photovoltaic systems. Wind-power direct-on-line generators and variable speed turbines.

Distributed Generation of Electricity:
Distributed generation overview. Demand-side management. Location selection of distributed generation. Power loss in distribution systems.

Embedded Generation:
Interconnection of RES technologies to the grid. Interconnection technologies. Point of common coupling. Interconnection considerations. Thermal limits. Voltage faults (voltage rise, flicker, distortion, phase voltage imbalance). Network losses. Fault levels. Islanding. Interconnection case study.</td></tr>
<tr><td>Teaching Methodology</td><td>Face- to- face</td></tr>
<tr><td>Bibliography</td><td>F.A. Farett and M.G. Simoes, Integration of Alternative Sources of Energy, John Wiley & Sons Inc.

F.P. Sioshansi, Smart Grid: Integrating Renewable, Distributed & Efficient Energy, Elsevier Inc.

IEEE Transaction on Energy Conversion (IEEE), Renewable Energy (Elsevier), International Journal of Sustainable Energy (Taylor & Francis), Progress in Photovoltaics (Wiley).</td></tr>
<tr><td>Assessment</td><td><table><tr><td>Examinations</td><td>70%</td></tr><tr><td>Assignments/Lab</td><td>20%</td></tr><tr><td>Class Participation and Attendance</td><td>10%</td></tr><tr><td></td><td>100%</td></tr></table></td></tr>
<tr><td>Language</td><td>English</td></tr>
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