

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NEED506	Power Electronics for Renewable Energy Systems	3	0	0	3
Course Objective						
<ul style="list-style-type: none">Different MPPT and control techniques using power electronic converters are the critical components of the major renewable energy extractions. However, the present course is also focused on the operations and analysis of different grid synchronization techniques for PV and wind generation systems. The design of different filter circuits and their performance analysis, etc., are also covered. However, strong fundamental knowledge about power electronic components, renewable energy and their interfacing are the prerequisite for the course.						
Learning Outcomes						
At the end of the course, students should be able to <ul style="list-style-type: none">Understand the operation of photovoltaic and wind energy systems and their controls.Understand the grid synchronization techniques with the renewable energy sourcesUnderstand the maximum power point (MPP) technique and the grid current control techniques.Design, develop and analyze the performance of the different filter circuits.						
Unit No.	Topics to be Covered		Lecture Hours	Learning Outcome		
1	Introduction to Renewable Energy sources: Review of renewable energy technology, Requirements of the grid for renewable energy systems.		5L	A comprehensive introduction to the course content will be delivered. The Review of different renewable energy technology will be discussed in detail.		
2	Solar Energy Extractions: PV system configurations, Solar cell technologies, Maximum power point tracking, DC-DC converters, conventional and multilevel converters and their PWM control strategies. Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors, Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems, Hybrid Systems and Solar Cars, Solar Energy Storage system and their economic aspects.		8L	This section explains the need and operations of the different power maximizing techniques for a PV system. The rating of the converters, filters can be done.		
3	Wind power Extractions: Wind power energy system, types of wind turbines, fixed speed and variable speed operation, Grid converters for wind power, control of converters for wind power extraction. Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.		8L	This section explains the need and operations of the different power maximizing techniques for a Wind generation system. The rating of the converters, filters can also be done.		
4	Grid synchronization: Grid synchronization techniques for single-phase and three-phase renewable energy systems, Islanding operation, grid filters, etc.		9L	Understand and analyze the different grid synchronization techniques for PV and Wind generation systems with the conventional power grid.		
5	Grid Current Control: Current control technique, Control of converters for fault-ride operation, etc.		7L	Explain the current control techniques required for the inverter control and their performance analysis under different conditions.		
6	Storage Systems: Configuration of battery energy and Fuel cells storage systems, sizing of storage elements, energy management, control, measuring of battery performance, charging and is charging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide - Mathematical Modelling for Lead Acid Batteries – Flow Batteries. Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages –Fuel Cell Thermodynamics.		5L	Study different energy storage technologies, their management, and rating selections are incorporated here.		
Total Contact Hours			42L			

Text Books:

- Grid Converters for Photovoltaic and Wind Power Systems- By Remus Teodorescu, Marco Liserre, and Pedro Rodríguez, 2011 John Wiley & Sons, Ltd.
- Control of Power Electronic Converters and Systems-Edited By Frede Blaabjerg, Academic Press

Reference Books:

- Modeling Power Electronics and Interfacing Energy Conversion Systems-By M. Godoy Simões Felix A. Farret, IEEE Press, Willey.
- Modeling and Control of Sustainable Power Systems Towards Smarter and Greener Electric Grids-Edited by Prof. Lingfeng Wang.