SEMESTER S5

RENEWABLE ENERGY SYSTEMS

Course Code	PEEVT 522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand the environmental issues with conventional fuels, the new methodologies/technologies for the effective utilization of renewable energy sources.
2. Familiarize with the characteristics of solar PV and wind power sources
3. Understanding of electronic conversion systems application to renewable energy generation systems and the synchronization with smart grid systems.
4. Equip the students to pursue further specialized areas of study such as renewable energy and green consumer electronics, industrial control systems and smart grid, and renewable energy system.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Renewable Energy (RE)Sources: World energy scenario, Over view of conventional energy sources, their limitation, need of renewable energy, potential & development of renewable energy sources ,Renewable energy in India, An overview of types of renewable energy systems - Wind power, Hydropower (micro and mini), Solar energy, Biomass, Bio-fuel, Geothermal Heat energy, Pros and cons; Applications	9
2	Solar Energy: Introduction to photovoltaic (PV) systems - Principle of PV conversion; Commercial solar cell, Thin film PV device fabrication - LPCVD, APCVD, PECVD; Tandem Solar cell fabrication; Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters, stand alone and grid collected PV	9

	systems, Grid interfacing-with isolation, without isolation, Maximum power point tracking- Methods(MPPT), PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.	
3	Wind Energy: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines-Rotor Turbines, Multiple-Blade Turbines, Drag Turbines, Lifting Turbines, System Toroidal Rotor Amplifier Platform (TARP)–Wind amplified rotor platform (WARP), Generators and speed control used in wind power energy: Fixed speed with capacitor bank, Rotor resistance control, SCIG and DFIG, Synchronous Generator- external magnetized, Synchronous Generator-permanent magnets.	9
4	Introduction to grid connectivity of RE systems, smart grid and emerging technologies, operating principles and models of smart gird components, key technologies for generation, networks, loads and their control capabilities; Evolution of electricity metering, key components of smart metering, overview of the hardware used for smart meters, smart metering protocols. Structure and main components of a distribution management system, Supervisory control and data acquisition (SCADA), distribution system modelling, new trends for smart grids, topology analysis, power flow analysis	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the need, importance and scope of various Non-Conventional sources of energy	**K2**
CO2	Outline the concepts and technologies related to renewable energy systems using Solar-PV	**K2**
CO3	Outline the concepts and technologies related to renewable energy systems using wind	**K2**
CO4	Understand the integration of smart grid with renewable energy systems and the fundamentals of Smart metering	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2						2					1
CO2	2											
CO3	2											
CO4	3		1									

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solar Energy: Principles of Thermal Collection and Storage	Nayak J. K. and Sukhatme S. P.	Tata McGraw Hill.	2006
2	Power Electronics: Circuits, Devices and Applications	Muhannad H. R	Pearson Prentice Hall	2004
3	Smart Grid Technology and Applications	Nick Jenkins, JanakaEkanayake, [et al.]	Wiley India Ltd	2012
4	Design of Smart Power Grid Renewable Energy Systems	Ali Keyhani	Wiley-IEEE Press	2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Non-Conventional Energy Sources	G.D. Rai	Khanna Publishers	2017
2	Renewable Energy Technologies	Ramesh & Kumar	Narosa Publishing House	2018
3	Integration of alternative sources of energy	Felix A. Farret, M. Godoy simoes	Wiley-IEEE Press	2006
4	Wind power plants and projects developments	Joshua Earnest and T Wizelius	PHI, New Delhi	2011
5	Handbook of renewable energy technology	Ahmed F Zobba, Ramesh C Bansal	World Scientific, Singapore	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/mh51mAUexK4?si=9O7PpRIU2ARBAVvV
2	https://youtu.be/5zAQot4pKgU?si=NH-k7lmY2ErQ5s73
3	https://youtu.be/bA-yMfHPazI?si=14PgB-_4stG9FdGC
4	https://youtu.be/vEFWXyOIYmU?si=q8UmAYoZOL0bW4_H