NIRMA UNIVERSITY
Institute of Technology
B. Tech. in Electrical Engineering
Semester – VI

L	T	P	C
2	0	2	3

Course Code	**2EEDE57**
Course Title	**Power Electronics in Renewable Energy Conversion**

Course Outcomes (COs):

At the end of the course, students will be able to-

1. evaluate the need of power electronics in renewable energy systems
2. choose and analyze various control algorithms and strategies
3. choose and apply converter topology for interfacing of various renewable energy sources to grid
4. identify and resolve various issues related with grid integration

Syllabus: **Teaching Hours: 30**

Unit-1: Photovoltaic Systems **06**

PV cell characteristics and equivalent circuits, model of PV cell, various parameters of PV cell and its datasheet study, effect of temperature on PV cell, fill factor, series and parallel connection of PV cell, interconnection of non-identical PV modules in series and parallel, solar geometry, solar incident energy with and without tilt angle, solar incident energy with atmospheric effects

Unit-2: Photovoltaic Technology **09**

PV array design and selection, Sizing of PV system without battery, PV system design with battery, MPPT techniques, input impedance model of power converters for MPPT, direct PV and battery connection, charge controller, battery charger design, multi axes solar trackers, sizing and design of stand alone PV system

Unit-3: Wind Energy System **03**

Wind in the world, wind energy scenario in India, speed and power relations, power extracted from wind, wind speed distribution, wind system components – tower, turbine blades, yaw control and speed control

Unit-4: Wind Generator Technologies **06**

Grid connected and self-excited induction generator operation, constant voltage and constant frequency generation, variable voltage and variable frequency generation, Double fed induction generator working principle and its operation, permanent magnet synchronous generator working principle and its operation

Unit-5: Renewable to Grid Interface **06**

Grid connection principle, PV and wind to grid topologies, three phase d-q controlled grid connection ac to dc and dc to ac transformations, three phase grid controlled connection, single phase grid controlled connection, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Experiments:

This shall consist of at least 10 experiments / simulations based on the above syllabus.

Suggested Readings:

1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, Tata McGraw Hill, New Delhi
2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, New York
3. J. Twidell and T. Weir, Renewable Energy Resources, Taylor & Francis
4. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Wiley IEEE Press
5. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons, Ltd
6. Joshua Earnest, Wind Power Technology, PHI learning.
7. S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems, Oxford publications.
8. Chetansingh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India Learning
9. Mukund R. Patel, Wind and Solar Power Systems, CRC Press, Florida
10. Non-Conventional Energy Resources, B. H. Khan, Tata McGraw Hill.
11. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, New Delhi
12. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, Inc., New York
13. K. R. Padiyar, Anil M. Kulkarni – Dynamics and Control of Electric Transmission and Microgrids, Wiley IEEE Press
14. Research Papers in reputed journals, Product Literatures, Datasheets

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2020-21 and onwards