WIND AND SOLAR ENERGY SYSTEMS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB46	Professional Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The students will try to learn:

1. The fundamental concepts of power generation and gain enough knowledge about the wind and solar energy sources.
2. The construction, principle of operation of various equipments used in power generation
3. The key aspects in the design and operation of photovoltaic along with solar thermal power energy systems.
4. The various factors affecting the power quality issues in integration of renewable energy resources.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

1. **Recall** the power conversions involved in windmills/ PV Systems for production of electricity.
2. **Outline** various components involved and their functionality in production of electricity from wind and Solar power plants.
3. **Summarize** the control schemes, environmental aspects and classification of wind energy conversion Systems for reliable operation.
4. **Outline** the characteristics of solar PV modules for design of solar arrays.
5. **Demonstrate** the functioning of various components involved in solar thermal systems for designing Commercial solar power plants.
6. **Develop** the suitable scheme for extracting maximum power from solar PV module using MPPT Algorithms.
7. **Utilize** the power conditioners and inverters for grid synchronization and harmonic reduction in solar PV Systems.
8. **Make use of** AC voltage controllers for power factor improvement and harmonic reduction in Isolated induction generators
9. **Identify** the power quality issues and mitigation techniques used in standalone and grid connected systems for ensuring the quality of power.
10. **Outline** the control and protection of renewable energy systems using custom power devices for stable Operation of power systems.

MODULE-I DESIGN AND OPERATION OF WIND POWER SYSTEM

Wind Power System: Components, turbine rating, electrical load matching, variable-speed operation, system design features, maximum power operation, system control requirements, speed control, rate control and environmental aspects, wind energy conversion systems and their classification.

MODULE-II	DESIGN AND OPERATION OF PV SYSTEM
Solar Photovoltaic Power System: The PV Cell, module and array, equivalent electrical circuit, open circuit voltage and short circuit current, I-V and P-V curves, array design, peak power point operation, PV system components; Solar Thermal System: Energy collection, synchronous generator, equivalent electrical circuit, excitation methods, electrical power output, transient stability limit, commercial power plants.	
MODULE-III	**POWER CONDITIONING SCHEMES FOR SOLAR ENERGY SYSTEMS**
Part-1 Switching devices for solar energy conversion: DC power conditioning converters, maximum power point tracking algorithms. **Part-2** AC Power conditioners, Line commutated inverters, synchronized operation with grid supply, Harmonic reduction.	
MODULE-IV	**WIND ENERGY CONVERSION SYSTEMS**
Wind energy Conversion system (WECS): Performance of Induction generators for WECS, Self-excited induction generator (SEIG) for isolated power generators. Controllable DC power from SEIGs, system performance, Grid related problems, generator control, AC voltage controllers, Harmonic reduction and Power factor improvement.	
MODULE-V	**POWER QUALITY ISSUES IN INTEGRATION OF RENEWABLE ENERGY RESOURCES**
Stand alone and Grid connected systems, Power Quality issues, Impact of power quality problems on DG, Mitigation of power quality problems, and Role of custom power devices in Distributed Generation.	

Text Books:

1. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 1st Edition, 1999.
2. Publications, 2nd Edition, 2001. G D Rai, "Non- Conventional Energy Resources", Khanna Publishers, 1st Edition, 2002.

Reference Books:

1. Daniel, Hunt. V Wind Power, A Hand Book of WECS, Van Nostrend Co., Newyork, 2nd Edition, 1998.
2. ArindamGhosh, Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Springer, 1st Edition, 2002.
3. Roger C Dugan, Mark E Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, "Electrical Power Systems Quality", TATA McGraw Hill, 2nd Edition, 2010.

Web References:

1. https://www.NPTEL video lectures.
2. https://www.books.askvenkat.com/engineering-textbooks
3. https://www.electrical4u.com.

E- Text Books:

1. Arindam Ghosh, Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices, Springer, 2002.
2. https://www.freebookcentre.net