**20EE31E4-WIND & SOLAR ENERGY SYSTEMS**

**(EEE)**

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| **Course Category:** | Professional Elective | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture-Tutorial-practical:** | 3-0-0 |
| **Pre-requisites:** | Generation of electric power, Power Electronics | **Sessional Evaluation:****External Exam Evaluation:****Total Marks:** | 4060100 |

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| **Course Objectives:** | Students undergoing this course are expected to learn: |
|  1.The history and basic concepts of wind power generation 2.The wind generator technologies 3.About the solar resources 4.The design of solar photovoltaic power generating units in  various modes. 5. The methods of solar thermal power generation. 6. About interconnected grid issues. |
| **Course Outcomes:** | After completing the course the student will be able to: |
| **CO1** | Understand concepts of wind power generation |
| **CO2** | Demonstrate the basic aspects of wind energy topologies. |
| **CO3** | Gain knowledge on working principle of solar energy systems. |
| **CO4** | Carry out basic design of solar energy system (Photovoltaic). |
| **CO5** | Acquire the knowledge about the different technologies used to harness solar energy depending on the temperature of operation.  |
| **CO6** | Enumerate the electronic devices developed for the integration of renewable energies and different challenges faced in power quality during network integration. |
| **Course Content:** | **UNIT-I****Introduction to wind power:** History of wind power, wind physics, Betz limit, tip speed ratio, stall and pitch control, wind speed statistics, probability distributions, wind speed and power.**UNIT-II****Wind generator topologies:** Review of modern wind turbine technologies, fixed and variable speed wind turbines, induction generators, doubly-fed induction generators and their characteristics, permanent magnet synchronous generators, power electronics converters.**UNIT-III****The solar resource:** Introduction, solar radiation spectra, solar geometry, earth sun angles, observer sun angles, solar day length, estimation of solar energy availability. **UNIT-IV****Solar photovoltaic:** Amorphous, Mono Crystalline, Polycrystalline, V-I characteristics of a PV cell, PV module, PV array, Solar Power Plant, maximum power point tracking (MPPT) algorithms.**UNIT-V****Solar thermal power generation:** Technologies, parabolic trough, central receivers, parabolic dish, fresnel, solar pond.**UNIT-VI****Network integration issues:** Overview of grid code technical requirements, fault ride through for wind farms, real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances, power quality issues. |
| **Text books****&****Reference books:** | **Text books:**1. “Wind power in power systems”, by T. Ackermann, John Wiley and Sons Ltd., 2005.2.“Renewable and efficient electric power systems”, by G. M. Masters, John Wiley and Sons, 2004.3.“Solar energy: principles of thermal collection and storage”, by S. P. Sukhatme, McGraw Hill, 1984.**Reference books:**1.“Grid integration of wind energy conversion systems”, by H. Siegfried and R. Waddington, John Wiley and SonsLtd., 2006.2.“Renewable Energy Applications”, by G. N. Tiwari and M. K. Ghosal, Narosa Publications, 2004.3.“Solar Engineering of Thermal Processes”, by J. A. Duffie and W. A. Beckman, John Wiley & Sons, 1991. |
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