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UNIVERSITY BAREILLY

| BPE701 | Wind and Solar Energy Systems | 3L:0T:0P | 3 credits |

Course Outcomes:

At the end of this course, students will demonstrate the ability to
- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Module 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies: (12 Hours)

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. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic: (8 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.Converter Control.

Module 5: Network Integration Issues: (8 Hours)

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 behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

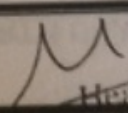**Module 6: Solar thermal power generation: (3 Hours)**

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.
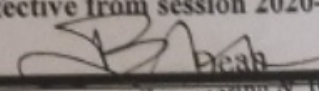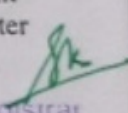
Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, " Solar Energy: Principles of Thermal Collection and Storage",

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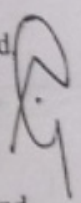Invertis University
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Effective from session 2020-21

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Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

McGraw Hill, 1984.

4. H. Siegfried and R. Waddington, " Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.

5. G. N. Tiwari and M. K. Ghosal, " Renewable Energy Applications" , Narosa Publications, 2004.

6. J. A. Duffie and W. A. Beckman, " Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.