B. Tech. (7th Sem) Electrical Engineering
BELE-537 (Wind and Solar Energy Systems)

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Continuous evaluation	40
End semester exam	60
Total marks	100
Credits	3.0

Course Objectives:

1. To familiarize the students about the various renewable energy sources
2. To give the brief idea about the needs of growing economy in energy sectors
3. To discuss about the basic physics of wind power, its history and basics of wind energy conversion system
4. To familiarize the students about the basic topologies used in Wind generator
5. To give the idea about the solar resources and solar photovoltaics
6. To discuss about the Network Integration Issues and solar thermal power generation

UNIT-1

Scenario of Renewable Energy (RE) Sources:

Needs of renewable energy, advantages and limitations of RE, present energy scenario of conventional and RE sources, Classification of Energy, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance.

UNIT-2

Physics of Wind Power:

History of wind power, basics of wind energy conversion system, effect of density, angle of attack and wind speed, Energy available from wind, basics of lift and drag, Tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm, Wind speed statistics-probability distributions.

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. Generator-Converter configurations, Converter Control.

UNIT-3

The Solar Resource:

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

Solar photo voltaic:

Technologies-Amorphous, mono crystalline, 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.

UNIT-4

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

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Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish solar pond, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning

Course Outcomes:

At the end of this course, students will:

1. Know the need of renewable energy resources, historical and latest developments.
2. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
3. Understand the basic physics of wind and solar power generation.
4. Understand the power electronic interfaces for wind and solar generation.
5. Understand the issues related to the grid-integration of solar and wind energy systems.
6. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.

Instructions for paper setter:

The question paper is divided into four sections A, B, C & D. Section A comprises of 12 questions of one mark each, three from each unit. Section B comprises of four questions of two marks each, one from each unit. Section C comprises of four questions of four marks each, one from each unit. Section D comprises of four questions of six marks each, one from each unit. Internal choice may be provided in section C, D if needed.

Text/ References Books:

1. T.Ackermann, "Wind Power in Power Systems",John Wileyand Sons Ltd.,2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. Mukund R. Patel, "Wind and Solar Power Systems: Design, Analysis, and Operation" , Taylor & Francis, Second Edition,2005.
4. H.Siegfried and R.Waddington, " Grid integration of wind energy conversion systems"John WileyandSonsLtd.,2006.
5. G.N.TiwariandM.K.Ghosal,"RenewableEnergyApplications",NarosaPublications,2004.

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