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IV Year B. Tech EEE II – Semester

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Grid Integration of Renewable Energy Systems
(Professional Elective-V)

Prerequisites: Power Systems, Power Electronics

Course Objectives:

1. To describe the concepts of different renewable energy sources
2. To explain the concepts of solar, wind energy, biomass, ocean energy, geothermal and hydro power generation system
3. To describe the utilization of different storage technologies
4. To analyze the issues involved in the integration of renewable energy sources to the grid

Unit1: Introduction (~7 Lecture hours)

Renewable Sources of Energy-Grid-Supplied Electricity-Distributed Generation Renewable Energy Economics-Calculation of Electricity Generation Costs – Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

Unit2: Solar and Wind energy Systems (~9 Lecture hours)

Solar thermal power generation. Solar Photovoltaics- energy conversion principle-classifications-equivalent circuit-characteristics-Cell efficiency-Limitations-PV modules-MPPT algorithms

Power and energy from wind - types of electric generators for wind power generation, Singly fed and doubly fed Induction generator, PMSM generator, Dynamics matching- performance of wind generators - economic considerations

Unit3: Other renewable energy sources (~9 Lecture hours)

Bioenergy, Bio-fuels - classification - biomass conversion technologies-applications; OTEC Systems, tidal energy - wave energy - Geothermal energy - mini, micro and pico-hydro power generation

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Unit4: Storage Devices (~9 Lecture hours)

Super capacitor-SMES- Battery storage - flywheel storage - compressed air storage- Fuel cells–types and applications; MHD generators – backup -System design-industrial and domestic applications of storage devices.

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Unit5: Integration of Alternative Sources of Energy with the grid

(~9 Lecture hours)

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.

Interconnection Technologies -Standards and Codes for Interconnection-Interconnection Considerations -Interconnection Examples for Alternative Energy Sources.

Text Books:

1. Felix A. Farret, M. Godoy Simoes, "Integration of Alternative Sources of Energy", John Wiley & Sons, INC, 2006.
2. D.Mukherjee & S.Chakrabarti: "Fundamentals Of Renewable Energy Systems", New Age International publishers, 2011.
3. Gilbert M. Masters: "Renewable and Efficient Electric Power Systems", John Wiley & Sons, INC, 2004.

Reference Books:

1. Rai G D, "Solar Energy Utilization", Khanna Publishers, 5th ed., 2004.
2. B H Khan, "Non-Conventional Energy Resources", Tata McGraw-Hill, 2nd ed., 2009.
3. Remus Teodorescu, Marco Liserre, Pedro Rodríguez: "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley & Sons, 2011.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Describe the concepts of different renewable energy sources
- Explain the concepts of solar energy conversion systems
- Explain the concepts of wind energy based electricity generation systems
- Describe the utilization of different storage technologies
- Describe the concepts of renewable energy sources like biomass, ocean energy and hydro power generation system
- Analyze the issues involved in the integration of renewable energy sources with the grid.

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