WIND ENERGY CONVERSION SYSTEM

**Course Objectives:**  
To introduce the technology, grid integration and energy assessment for the wind power system to the final year BE student.

1. **Wing Power Basics (8 hours)**
   1. Historical evolution of wind power system
   2. Change in size and output
   3. Wind energy conversion system: turbine, generator, power electronics, grid
   4. Wind power plant and wind mill
   5. Economics
      1. Wind fluctuations
      2. Capacity credits
      3. Embedded generation benefits
      4. Storage
   6. Future trend: Cost, capacity, integration issues.

1. **Wind energy assessment (10 hours)**
   1. Power in the Wind : temperature, altitude correction, impact of Tower Height
   2. Maximum Rotor Efficiency
   3. Average Power in the Wind
      1. Discrete Wind Histogram
      2. wind Power Probability Density Functions
      3. Weibull and Rayleigh Statistics
      4. Average Power in the Wind with Rayleigh Statistics
      5. Wind Power Classification
   4. simple Estimates of Wind Turbine Energy
   5. Annual Energy using Average Wind Turbine Efficiency
   6. Wind Farms
   7. Specific wind Burtine Performance Calcualtions: aerodynamics, power curve and Weibull statistics
   8. Wind Turbine Economics 371
      1. Capital Costs and
      2. Annual Costa 371
      3. Annualized ost of Electricity from Wind Turbines

1. **Technology of wind energy conversion system (8 hours)**
   1. Wind Turbines
   2. Generators
   3. Power Electronics Interfaces
   4. Classification of WECS
      1. Fixed speed based wind turbines
      2. Partially rated Converter‐based (FRC) Wind Turbines
      3. Fully Rated converter‐based (FRC) Wind Turbines

1. **Integration of WECS (8 hours)**
   1. Interconnection issues
   2. Operation of off‐grid mode:hybrid system
   3. Operation in grid connected mode
   4. Fault ride through

1. **Wind power and electricity markets (8 hours)**
   1. Introduction
   2. The electrical energy market
   3. Balancing, capacity and ancillary services
   4. Support mechanisms
   5. Costs
   6. Investment and risk
   7. The future

**Practical Works:**

1. Wind Energy assessment of the particular location
2. Analysis of different wind turbine generation systems
3. Case Study on technology and issues related grid integration of WECS
4. Market Analysis of WECS

**Reference:**

1. Wind Power in Power Systems, edited by Thomas Ackermann, Wiley publication, 2nd edition, 2004
2. Renewable and efficient power system
3. Wind Energy: Fundamentals, Resource analysis and Economics, Mathew Sathyajith, 2006
4. Wind Energy Explained: theory, Design and Application, James F. Manwell, Jon G. McGowan, Anthony L. Rogers, 2010.