

**FIRST SEMESTER 2019-2020**

# Course Handout Part II

01-08-2019

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : ME F483

## Course Title : Wind Energy

## Instructor-in-Charge : Sabareesh G R

**Scope and Objective of the Course:**

A state of the art treatment of wind energy resource, engineering and technological aspects would be presented in a greater detail in the course. This would be complemented by economic, commercial and social aspects of wind energy harnessing and utilization. At the end of the course the student would be able to apply the principles learnt to (a) identify the sites for wind energy harnessing (b) design wind energy harnessing systems for various applications (c)perform necessary techno-economic analyses for selecting appropriate wind energy systems

**Textbooks:**

1. Sathyajith Mathew, Wind Energy - Fundamentals, Resource Analysis and Economics, Springer-Verlag Berlin Heidelberg 2006

**Reference books**

1. J. F. Manwell and J. G. McGowan, Wind Energy Explained- Theory, Design and Application, John Wiley & Sons Ltd, West Sussex, United Kingdom, 2009
2. John D Holmes, Wind Loading of Structures, 2nd Edition, Taylor & Francis, 2007
3. A R Mohanty, Machinery Condition Monitoring: Principles & Practices-CRC Press
4. Erich Hau, Wind Turbines-Fundamentals, Technologies, Application and Economics, 2nd edition, Springer

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction | History of wind energy, Current status and future prospects | 1 of TB1 |
| 2-5 | Basics of Wind Energy Conversion | Power available in the wind spectra, Wind turbine power and torque, Classification of wind turbines, Horizontal axis wind turbines, Vertical axis wind turbines; Darrieus rotor; Savonius rotor; Musgrove rotor | 2 of TB1 |
| 6-8 | Analysis of wind regimes | The wind: Local effects; Wind shear; Turbulence; Acceleration effect; Time variation | 3 of TB1 |
| 9-10 | Measurement of wind | Ecological indicators, Anemometers: Cup anemometer; Propeller anemometer; Pressure plate anemometer; Pressure tube anemometers; Sonic anemometer; Wind direction | 3 of TB1 |
| 11-13 | Analysis of wind data | Average wind speed; Distribution of wind velocity  Statistical models for wind data analysis | 3 of TB1 |
| 14-15 | Energy estimation of wind regimes | Weibull based approach; Rayleigh based approach | 3 of TB1 |
| 16-17 | Characteristics of wind rotors, Aerodynamics of wind turbines | Introductory airfoil theory Airfoil, Aerodynamic theories, Axial momentum theory, Blade element theory, Strip theory, Rotor design, Rotor performance | 2 of TB1 |
| 18-20 | Wind farms, Offshore wind farms,  Wind pumps | Wind powered piston pumps, Limitations of wind driven piston pumps: The hysteresis effect; Mismatch between the rotor and pump characteristics; Dynamic loading of the pump’s lift rod; Double acting pump; Wind driven roto-dynamic pumps; Wind electric pump | 4 of TB1 |
| 21-22 | Performance of wind energy conversion systems | Power curve of the wind turbine; Energy generated by the wind turbine | 5 of TB1 |
| 23-24 | Performance of wind powered pumping systems | Wind driven piston pumps, Wind driven roto-dynamic pumps,Wind electric pumping systems | 5 of TB1 |
| 25 | Wind energy and Environment | Environmental benefits of wind energy | 6 of TB1 |
| 26-31 | Wind turbine Installation | Wind structure interaction, Basic bluff body aerodynamics, Interference effects, Wind turbine aerofoil design, Wind turbine foundation characteristics, terrain effects, Wind loadings | 4 of TB1,  4,11,15 of RB2 |
| 32-34 | Wind turbine mechanical systems and materials | Gear Box fundamentals, speed and torque relations, force loads on gears, Material considerations and characteristics of materials for various components of wind turbines | 6,7 of RB4 |
| 35-37 | Wind turbines Condition monitoring | General problems of gears and gear failure, Vibration, acoustics, lubricating oil monitoring of gear boxes in wind turbines | RB3 |
| 38-39 | Economics of wind energy | Factors influencing the wind energy economics: Site specific factors; Machine parameters; Energy market; Incentives and exemptions | 7 of TB1 |
| 40-42 | The ‘present worth’ approach, Cost of wind energy, Benefits of wind energyYardsticks of economic merit | Initial investment; Operation and maintenance costs; Present value of annual costs, Net present value; Benefit cost ratio; Payback period; Internal rate of return | 7 of TB1 |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid-Semester Test | 90 min | 25% | 4/10, 9.00 -- 10.30 AM | Closed book |
| Comprehensive Examination | 180 min | 35% | 11/12 FN | Closed book |
| Project |  | 20% |  | Open book |
| Term paper |  | 20% |  | Open book |

**Chamber Consultation Hour: To be announced in the class**

**Notices:** To be displayed on ME notice board/CMS only

**Make-up Policy: Only for genuine cases with prior permission**

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**