Birla Institute of Technology & Science, Pilani
Hyderabad Campus

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:

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:

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