Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST/ ~~SECOND~~ SEMESTER 2021-2022

Course Handout Part II

Date: 20-08-2021

In addition to part I (general handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course no : ME F483
Course title : Wind Energy
Instructor in charge : M. Srinivas

1. Course Description

Historic development of wind energy technology, basic principles of wind energy conversion, different types of wind machines and their performances, wind rotor aerodynamics and its application in the turbine design, statistical methods of measurement and analysis of wind spectra for energy use, developing models for estimating the wind energy potential of a prospective site, Constructional features of various systems and sub-systems of a Wind Energy Conversion System(WECS), Features of wind farms, performance models of WECS, Optimal matching of WECS, environmental aspects of wind energy conversion, Economics of wind energy conversion.

2. Scope and objective

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.

3. Text books

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

4. 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. Ahmad Hemami, Wind Turbine Technology, Cengage Learning, 2012

5. Course plan

Lecture	Learning objective	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

Lecture	Learning objective	Topics to be covered	Chapter in the Text Book
6-10	Characteristics of wind rotors, Aerodynamics of wind turbines	Airfoil, Aerodynamic theories, Axial momentum theory, Blade element theory, Strip theory, Rotor design, Rotor performance	2 of TB1
11-13	Analysis of wind regimes	The wind: Local effects; Wind shear; Turbulence; Acceleration effect; Time variation	3 of TB1
14-15	Measurement of wind	Ecological indicators, Anemometers: Cup anemometer; Propeller anemometer; Pressure plate anemometer; Pressure tube anemometers; Sonic anemometer; Wind direction	3 of TB1
16-18	Analysis of wind data	Average wind speed; Distribution of wind velocity Statistical models for wind data analysis, Weibull distribution, Rayleigh distribution	3 of TB1
19-20	Energy estimation of wind regimes	Weibull based approach; Rayleigh based approach	3 of TB1
21-22	Wind energy conversion systems	Wind electric generators: Tower; Rotor; Gear box; Power regulation; Safety brakes; Generator; Induction generator& Synchronous generator; Fixed and variable speed operations; Grid integration	4 of TB1
23-25	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
26-28	Performance of wind energy conversion systems	Power curve of the wind turbine; Energy generated by the wind turbine: Weibull based approach; Rayleigh based approach	5 of TB1
29-32	Performance of wind powered pumping systems	Wind driven piston pumps, Wind driven roto-dynamic pumps, Wind electric pumping systems	5 of TB1
33	Wind energy and Environment	Environmental benefits of wind energy	6 of TB1
34-35	Life cycle analysis	Net energy analysis; Life cycle emission	6 of TB1
36-37	Environmental problems of wind energy	Avian issues; Noise emission; Visual impact	6 of TB1
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 energy Yardsticks 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 Minutes	30	19/10/2021 1.30 - 3.00PM	OB
Surprize tests/quizzes*	10 Minutes	20	To be announced	OB
Written reports on assignments/projects@	Take home	10	To be announced	OB
Comprehensive Examination	120 Minutes	40	15/12 AN	OB

* Best 4 out of 5. Other details would be communicated separately.
@ No of assignments/projects is one, the topic of which would be given to the students. The reports are to be submitted in hand written format. Other details would be communicated separately

Chamber Consultation Hour: To be announced in the class.

Notices: All notices concerning this course shall be displayed on the CMS (the Institute's web based course management system). Students are advised to visit regularly CMS for latest updates.

Make-up Policy: Make-up shall be given only to the genuine cases with prior confirmation. Request for the make-up tests, duly signed by the students, should reach the under signed well before the scheduled test.

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
ME F483