

Course no.:	ENR 113
Course title:	Wind Power Generation
Core or elective:	Elective
Number of credits:	3
Number of lectures-tutorials-practical:	16-8-18
Course coordinator:	Dr. Najmur Rahman

Course Objectives:

Wind being an environmentally sound source of energy, is becoming increasingly economically competitive with conventional sources. Hence, understanding of wind generation is of utmost importance. Also, wind energy is now becoming utility scale and can affect planning and operation of both generation and transmission systems. Utilities with significant wind potential in their service territories needs to study the technical impacts of incorporating the wind plants in their systems. This course is designed to give students in depth understanding of wind generators, their integration to electric grid, related technical and economic challenges.

Evaluation procedure:

- Assignments: 50%
- Minor project: 20%
- Major test: 30%

Details of course content and allotted time

S. No.	Topic	Allotted time (hrs)		
		L	T	P
1	<p>Introduction:</p> <p>Review of wind resource assessment, basic laws and concepts of aerodynamics (2-D, 3-D aerodynamics).</p> <p>Description and performance of the horizontal-axis wind machines, description and performance of the vertical-axis wind machines.</p> <p>Site Selection – Wind climatology, terrain features, surface roughness etc.</p> <p>Micro siting of wind turbines, site Identification, wind mast installation.</p> <p>Annual Energy Output estimation</p> <p>Uncertainties in estimation</p> <p>Probabilities of Estimation</p>	8		
2	<p>Wind Power Project Planning & Structuring:</p>	4		

S. No.	Topic	Allotted time (hrs)		
		L	T	P
	<p>Bank ability of Projects:</p> <p>Promoters, Financing, Balance Sheet, Non Recourse or Project Finance, Leasing, Taxation Issues</p> <p>Electricity Off Take Arrangements & Structures:</p> <p>PPA with utility, Captive, Group Captive, Open Access & Merchant Sale</p> <p>Project Contracts:</p> <p>Wind Turbine Supply Contracts, Works Contracts, E&C Contract, O&M Contract</p> <p>Risk Mitigation</p> <p>Indemnities & Liabilities</p> <p>Power Curve Measurement</p> <p>Project Management: Project Implementation Activities, Pert/ CPM/ MS Projects, Quality Assurance in Project Implementation.</p>			
3	<p>Project Works:</p> <p>Soil Tests, Excavation, Civil Works, Foundations, Buildings, Roads ,Concrete Tests, Erection & Commissioning, On site Sub Assembly, Selection of cranes and crane types, Erection, Commissioning Tests, Internal Electrical Lines, Switch Gear, Grid interconnection, Metering, Sub Station</p> <p>Operation & Maintenance Management:</p> <p>Management of Maintenance, Predictive Maintenance, Preventive Maintenance, Planned Maintenance</p>	4		
4	<p>Seminar:</p> <p>This part consists of studying the various cases of wind energy systems, the concept and associated challenges. For this part students</p>		8	

S. No.	Topic	Allotted time (hrs)		
		L	T	P
	may take up papers from peer reviewed journal on wind energy and discuss the new technology, advantages, and challenges. (The students may also design wind farms of various capacities considering the micro siting guideline for each state and arrive at different wind farm layouts.)			
5	Simulation Lab: In this lab students can calculate the Annual Energy Production of the wind farm using WASP, Wind Farmer. They can also perform various studies related to resource assessment, feasibility assessment and electrical performance.			18
	Total	16	8	18

Recommended readings

1. Martin OL Hansen: **Aerodynamics of Wind Turbines**, 2nd ed. (Earthscan, London)

Additional reading:

1. www.windpower.org
2. www.wasp.dk
3. www.garradhassan.com
4. www.indianwindpower.com
5. www.cwet.tn.nic.in
6. www.wwe-tp.com

Reviewers:

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Mr. Mahesh Vipradas, Senergy Global Pvt. Ltd., Delhi