

Engineering Program

Specialization	Energy Technology
Course Number	020304261
Course Title	Wind energy technology
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Brief Course Description:

Introduction to wind energy , Wind Characteristics: wind Power ; wind shear; power potential ; direction ; duration curve ; turbulence , Wind Resource , wind measurements, wind map. Wind Turbines , Wind Power Systems , Design of Wind Turbines , wind power plant performance, sitting of wind power plants , Applications and Wind Industry , Economics of wind turbines.

Course Objectives:

The student should be able to:
Understand the fundamentals of wind energy and its conversion techniques for electrical energy applications

□ Detailed Course Description:

Unit Number	Unit name	Unit Content	Time Needed
1.	Introduction	<ul style="list-style-type: none"> Introduction to wind energy , Wind Characteristics: wind Power 	
2.	WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS	<ul style="list-style-type: none"> Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis 	
3	AERODYNAMICS THEORY & WIND TURBINE TYPES	<ul style="list-style-type: none"> Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator 	

<p>4</p>	<p>GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION</p>	<ul style="list-style-type: none"> ▪ Electronics Sensors /Encoder /Resolvers, Wind Measurement : Anemometer & Wind Vane, Grid Synchronisation System, Soft Starter, Switchgear [ACB/VCB], Transformer, Cables and assembly, Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, Safety Chain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay for Generator, Battery/Super Capacitor Charger & Batteries/ Super Capacitor for Pitch System, Transient Suppressor / Lightning Arrestors, Oscillation & Vibration sensin 	
<p>5</p>	<p>DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE) [VARIABLE SPEED VARIABLE FREQ.]</p>	<ul style="list-style-type: none"> ▪ Excited Rotor Synch.Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits 	

6	MODERN WIND TURBINE CONTROL & MONITORING SYSTEM	▪	
7		▪	

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□ **Evaluation Strategies:**

		Percentage	Date
1. Exams	Midterm exam	40%	--/--/----
	Assignments	10%	
	Final Exam	50%	--/--/----

□ **Teaching Methodology:**

1. Lecture

□ **Textbook:**

□ **References:**

1. Wind power; renewable Energy for home, farm & Business; Paul Gipe, 2004 .
2. Renewable Energy ; Bent Sorensen , 2004
ISBN 0-12-656153 -2
3. Freris, L.L., Wind Energy Conversion Systems, Prentice Hall, 1990 2.
Kaldellis J.K, Stand – alone and Hybrid Wind Energy Systems, CRC Press, 2010
4. Mario Garcia –Sanz, Constantine H. Houpis, Wind Energy Systems,CRC Press 2012 4. Spera, D.A., Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, 1994. 5. Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
5. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, 1996