Course Code ESE-817	Credit Hours (Th-Pr) 3.0-0	**Wind Energy (Elective)**	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

Energy conversion process in Wind Turbines

Evaluation of Wind Resources

Wake Effect and Wind Parks

Wind Park Business

Wind Energy Technology

Actuator Disc theory

Wind Turbine theories

Eligibility Criteria: B.E (Chemical, Mechanical, Electrical, Environmental and Materials)

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Wind Power Plants: Fundamentals, Design, Construction and Operation	Gasch, Robert & Twele, Jochen	GRT	Text
2.	Wind Turbine Engineering Design	Eggleston	EG	Text
3.	Wind Energy: Fundamentals, Resource Analysis and Economics	Mathew Sathyajith	MS	Reference
4.	Wind Energy: Renewable Energy and the Environment	Vaughn C. Nelson	NV	Reference

Course Objectives:

Main objective of this course is to provide a general introduction to wind turbines including the history and development of the wind energy industry, components of wind turbines, and how they work together to produce energy. An analysis of how the turbine converts wind to electrical power will be covered also.

Learning outcome:

Evaluation of wind turbine blade design; computation of the degree of energy transfer; assessment of mechanical loads & design/construction of windmill platforms; Transmission systems appraisal

Topics Covered:

No.	Topics	Text Book	Contact Hours
1.	**Energy conversion process in Wind Turbines** • Wind Resource as input for a Wind Energy Converter • Aero-dynamic and Mechanical Aspects of Wind Turbines • Construction Principles of Wind Turbines • Power Characteristics of Wind Turbines • Control Systems • • Electronic Control and Grid Integration	GRT	7
2.	**Evaluation of Wind Resources** • Weibull-Distribution • Wind velocity measurements to determine energy yield • WAsP-Method, Partial models using WAsP • MCP Method of long-term corrections of wind measurement data in correlation to long-term reference data • Conditions for stable, neutral and instable atmospheric conditions • Wind yield from wind distribution and the power curve • Appraising the yearly wind yield from a wind turbine	GRT	6
3.	**Wake Effect and Wind Parks** • Recovery of original wind fields in the downstream of wind turbines • Risø Models • Spacing and efficiency in wind parks • Foundation of off-shore wind turbines • Positive and Negative Effects of Wind Parks	GRT	6

4.	**Wind Energy Technology** • Electrical system, rotation speed, steep installation • Mechanical load and moment • Mechanical load • Electrical system rotation speed, variable installation • Measurements from load and moment, strain gauge test bridge, fatigue extrapolation • Wind diesel systems in small island grids (ca. 30kW) • Actuator Disc theory • Horizontal Axis wind turbine theories • Vertical Axis wind turbine optimization theories.	EG & GRT	8
5.	**Wind Park Business** • Income from the energy yield from wind parks • Three-Pillar model of Sustainability: "magic triangle" • Profit optimization by increase of energy production	GRT	6
6.	**Wind Flow** • Origin and Potential of atmospheric energy movements, Heat balance of the atmosphere • Physical laws of atmospheric flow • Wind circulation in the atmosphere, Local Winds • Wind flow in atmospheric layers(Vertical Structure, Ekman Layer) • Assessment of Wind potential(European Wind Atlas: Model, Concept)	GRT	6
7	**Types of wind energy conversion systems:** Dutch windmills, multiblade water-pumping wind mills, high-speed propeller-type wind machines, the savonius rotor, the darrieus rotor. New developments: Small turbines; Large turbines. Applications	GRT	6