REM master basic syllabus

Title:
NE6003 Wind Energy Engineering

Credit value:
5 ECTS

Mandatory/Optional:
Optional

Semester:
1

Lecturer/s:
Paul Leahy

University:
University College Cork

Department:
School of Engineering

Rationale:
This module aims to introduce students to wind energy theory and technology, resource assessment and wind farm site development.

Objectives:
On successful completion of this module, students should be able to:

- *Outline the origin of global, geostrophic and surface winds*
- *Explain the impact of surface roughness and orography on wind speed profiles*
- *Calculate wind speed at a given height using the log law and power law*
- *Derive the Betz equation for wind power extraction using an idealized wind turbine*
- *Discuss different approaches to wind power forecasting and the relative benefits and limitations of each*
- *Apply aerodynamic theory to analyse passive and active wind turbine stall control operations*
- *Prepare a site visit report for a wind farm*
- *Model wind farm energy production using appropriate wind farm software tools.*

Skills: *(according to the list of skills provided)*

Subject skills	**REM Master Skills**						
	L2.1	**L2.2**	**L2.3**	**L2.4**	**L2.5**	**L2.6**	**L2.7**
L3.1. Understand how wind is generated and influenced by global, regional and local factors and quantify the wind energy resource	X						
L3.2. Analyse the performance of a complete wind farm design, including turbines and their subsystems (e.g. rotors, control systems), wakes, balance of plant and grid connection	X	X	X				X
L3.3. Explain environmental and social impacts of wind energy and the wind farm development, operation and decommissioning phases		X			X	X	X
L3.4 Read wind energy forecasts and extract and apply the necessary information to make operational decisions	X		X				

Teaching and learning methods:

The teaching method is based on a series of lectures where the lecturer explains the main concepts through power point presentations and worked out examples on the board. The students are also presented with a variety of issues of practical nature during the lectures. The module also includes a site visit to an operational wind farm. Students must write a written report on the site visit. There is also a group design assignment – students work in small groups to develop a wind farm layout, estimate energy yield, apply measure-correlate-predict to estimate long term variability, and consider environmental constraints. The design assignment is supported by tutorial sessions.

Allocation of student time:

	Attendance (classroom, lab,…)	**Non attendance (lecture preparation, self study…)**
Lectures	24 hours	10 hours
Tutorials	3 hours	0 hours
Assignment	10 hours	20 hours
Private study		41 hours

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Assessment:

Site visit report, design report and final written exam test students' achievements of the learning outcomes.

Assessment Matrix:

Subject skills	**Assessment method**					
	Exam	**Class test**	**Coursework**	**Report**	**…**	**…**
All	80%	-	10%	10%		

Programme:

Lesson 1	***Introduction to wind energy industry, historical development and current status*** *Distribution (2 h theory)*
Lesson 2	***Wind characteristics and resources. Vertical Wind Profile.*** *Distribution (2 h theory)*
Lesson 3	***Terrain Effects. Available Wind Power.*** *Distribution (2 h theory)*
Lesson 4	***Aerodynamics. Rotors. Blade Element Momentum Method. Wakes.*** *Distribution (2 h theory)*
Lesson 5	***Wind Turbine Systems and Control.***

	Distribution (2 h theory)
Lesson 6	***Wind Measurement and Resource Assessment*** *2 h*
Lesson 7	***Electrical technology for wind turbine generators. Grid Integration.*** ***3h***
Lesson 8	***Noise impacts*** ***1h***
Lesson 9	***Wind Farm Design I : Weibull Statistics, Measure-Correlate-Predict & Energy Yield*** ***2h***
Lesson 10	***Wind Farm Design II: Layouts, Array Effects & Uncertainty*** ***3h***
Lesson 11	***Operations and Maintenance; Decommissioning*** ***1h***
Lesson 12	***Wind Forecasting*** ***2h***

Resources:

A classroom, equipped with a blackboard and audio-visual resources (laptop/computer and Internet connection + projector), for the lectures.
For design tutorial: a room suitable for group work (groups of 4-5).

Bibliography:

Wind Energy Explained – theory, design and application by J.F. Manwell, J.G. McGowan and A.L. Rogers. Published by Wiley.

Burton et al, 2012, Wind Energy handbook, 2nd Ed., Wiley

Wind Power Plants – fundamentals, design, construction and operation by Robert Gasch and Jochen Twele. Published by Solarpraxis AG, Germany in association with James and James Ltd.

Wind Energy – The Facts [online] https://www.wind-energy-the-facts.org/

Further comments: