

INTRODUCTION COURSE IN WIND ENERGY

(24 hours)

	TOPICS	DURATION-Hours
1	<i>Introduction to wind energy</i>	2
	Content	Global challenges of climate change, solar radiation and wind energy, the need for wind energy for power generation, uses of wind energy in the past, wind potential in various locations.
	Knowledge	On climate change, solar energy and creation of wind power, its potential for electricity generation, past uses of wind energy.
	Skills	Ability to recognize the problem of climate change, to perceive the necessity of renewable energy sources with emphasis on solar and wind power and to gain a rational understanding of wind energy engineering.
	Competences	Ability to delve into the scientific issues of climate change and the technologies of solar and wind power and to identify autonomously the potential for renewable energy and specifically wind energy.
2	<i>History of wind turbines</i>	2
	Content	Uses of wind mills in the past, use of wind energy for water pumping, past uses of wind turbines for power generation, evolution of wind turbines,

		modern on-shore and off-shore wind turbines.
	Knowledge	On the uses of wind mills in the past and on their evolution over time, modern wind turbines.
	Skills	Ability to identify the periods of wind turbine technology, its use, evolution and the differences between on-shore and off-shore wind turbines.
	Competences	Ability to be responsible to observe the evolution of wind energy technology, compare it with the past and understand autonomously why wind energy has been used timelessly and its evolution through time.
3	Wind resources	2
	Content	Atmospheric turbulence, energy content of the wind, relation of wind velocity and wind energy, change of wind speed with height from the ground, change of wind energy according to the landscape, wind resources in Europe.
	Knowledge	Estimation of wind energy and its dependence from various parameters, relation of wind energy to the height and the landscape, wind potential in Europe.
	Skills	Ability to estimate the energy of the wind and its dependence from various environmental parameters.
		Ability to choose the most appropriate wind resource, and responsibility on how to use wind energy, depending on the circumstances given

	Competences	from the environmental factors of a specific area, such as the landscape and the wind speed.
4	Wind resources measurement	2
	Content	Instruments for wind speed measurements: a) Cup anemometer, b) Sonic anemometer, c) Remote sensing of wind-spinning lidar, Doppler equation.
	Knowledge	Use and characteristics of various instruments measuring wind speeds.
	Skills	Ability to choose the appropriate instrument to measure the wind speed.
	Competences	Ability to draw upon the knowledge and skills gained within the studies to measure autonomously wind speed in different situations with different instruments, at possible places of solar and wind power plants.
5	Wind electricity generation	2
	Content	Estimation of the electricity generated by wind turbines, The coefficient C_p and its dependence on various parameters, Characteristic curve of a wind turbine, Nominal power, Nominal velocity, Starting and ending velocity of a wind turbine.
	Knowledge	Estimation of electricity generated by wind turbines, characteristic curve of wind turbines and some important parameters influencing the

		generated energy.
	Skills	Ability to estimate the energy generation from a wind turbine and to realize its characteristic curve.
	Competences	Ability to calculate autonomously specific parameters in order to succeed in the goal of producing the highest possible generated energy and having the responsibility of adjusting a wind turbine plant and its electricity production.
6	<i>Cost of wind farms</i>	1
	Content	Phases in wind turbine creation, development-implementation-operation-decommissioning, cost components of a wind farm, Indicative costs of wind turbines and farms.
	Knowledge	Separate stages in wind turbine development, capital cost of wind turbines.
	Skills	Ability to estimate the capital cost of wind turbines.
	Competences	Ability to conduct autonomously financial assessments for the cost of installing and running a wind farm and choosing the most cost-effective one.
7	<i>Economics of wind farms</i>	1
	Content	Tools for assessing the economic viability of wind turbines, energy production and revenues, simple equation for estimating the wind energy

		generation, various schemes for wind electricity revenues, cost of wind energy generation, profitability of wind farms.
	Knowledge	How to estimate the energy generated by wind turbines, the revenues the costs and the profitability.
	Skills	Ability to estimate the costs, revenues and profitability of a wind turbines.
	Competences	Ability to conduct autonomously financial assessment for the viability of operating wind turbines, responsibility of management of wind farms and making a cost-benefit analysis by choosing the most profitable one.
8	<i>Wind energy technology concepts - components of wind plants</i>	2
	Content	Components of wind turbines, Rotor, Nacelle converting torque to power, tower, foundation, horizontal and vertical rotors in wind turbines.
	Knowledge	Various types of wind turbines, separate parts and components of wind turbines.
	Skills	Ability to understand and recognize the wind energy technology concepts, characteristics & components of wind plants and its use.
	Competences	Ability to work autonomously in technical support of wind turbines plants and in manufacturing of those plants and be responsible to suggest the

		most suitable components of wind plants.
9	<i>On-shore and off-shore wind turbines</i>	1
	Content	Off-shore wind turbines and farms, requirements for off-shore wind turbines, foundation of turbines in the sea, maintenance.
	Knowledge	Off-shore wind turbines, their requirements and their maintenance.
	Skills	Ability to realize the problems during wind turbine foundation.
	Competences	Ability to apply problem solving strategies about turbine foundation, autonomously maintain wind turbines and farms and be responsible to address the requirements for on-shore and off-shore turbines.
10	<i>Properties of wind turbine components</i>	2
	Content	Main components in wind turbines, Properties for Rotor, Nacelle, tower and foundation.
	Knowledge	Properties and requirements of various components in wind turbines.
	Skills	Ability to recognize and understand the main components and properties of wind turbines and its function.
		Responsibility to suggest the most suitable

	Competences	components of wind turbines regarding their properties, design and maintenance requirements
11	<i>Materials requirements for wind turbine blades</i>	1
	Content	Calculation of the loads working on a wind turbine blade, calculation of stresses working in the blade material, estimation of the number of load cycles on a wind turbine blade.
	Knowledge	How to calculate various parameters influencing wind turbine life.
	Skills	Ability to calculate some useful parameters in wind turbine operation.
	Competences	Ability to autonomously suggest the most suitable material of wind turbine blades depending on the requirements and the calculations of technical parameters in every occasion.
12	<i>Composite materials for wind turbine blades</i>	1
	Content	Use of uniaxial composites in wind turbine blades, calculation of stiffness and strength of composite materials, estimation of the fatigue limit of a composite, fiber's reinforced polymers, glass and carbon fibers.
	Knowledge	Requirements of composite materials used in wind turbine construction.

	Skills	Ability to realize the requirements and choose the composite materials used in blades.
	Competences	Ability to reflect upon his/her own action in order to select the most suitable composite materials for turbine blades.
13	<i>Flow and forces around the wind turbine blade</i>	1
	Content	Velocity triangle for the flow around a wind turbine blade, aerodynamic forces driving the rotor around, lift of a blade section from an airfoil curve.
	Knowledge	Air movement around wind turbine blades and forces influencing energy generation.
	Skills	Ability to perceive the concept of aerodynamic forces driving the rotor around, calculate velocity triangles for the flow around a wind turbine blade and make an airfoil curve.
	Competences	Responsibility of adjusting appropriately wind turbine blade by taking into consideration the flow and forces for the effective operation of a wind turbine blade.
14	<i>Grid connection of wind turbines</i>	1
	Content	Four main electrical design concepts, asynchronous generators, variable rotor resistance, small or larger converter, power transmission with AC or DC current.

	Knowledge	Different designs in connecting wind turbines with the electric grid.
	Skills	Ability to realize the different configurations for connecting wind turbines with the grid.
	Competences	Responsibility of installing and operating wind turbines by combining complex technical devices in order to connect wind turbines with the grid in the most effective and safe way .
15	<i>Control of wind turbines and wind power plants</i>	1
	Content	Main objectives of controlling wind turbines, pitch control and active staff control, maximum power point tracking, control architecture in wind power plants.
	Knowledge	Different designs for controlling wind turbine plants and optimizing the generated power.
	Skills	Ability to realize the different configurations for controlling wind turbines.
	Competences	Responsibility for managing the control systems by selecting the most appropriate and effective designs for controlling wind turbines plants and the ability to coordinate the staff by dispensing autonomously specific tasks to employees.
16	<i>Siting of wind turbines and wind</i>	1

	<i>farms</i>	
	Content	Choosing the optimum site for installation of wind turbines, analysis of landscape and wind velocity data.
	Knowledge	Methodology for optimum sitting of wind turbines and farms.
	Skills	Ability to find the optimum site for wind turbines installation.
	Competences	Responsibility for choosing the optimum site for wind turbines after analyzing autonomously landscape and wind velocity data.
17	<i>Environmental impacts of wind farms</i>	1
	Content	Environmental impacts during installation, operation and decommissioning, impacts on landscape, noise creation, impacts on birds life.
	Knowledge	Environmental problems and impacts during construction and operation of wind farms.
	Skills	Ability to assess the environmental problems during installation, operation and decommissioning of wind turbines.
		Ability to draw upon the knowledge and the skills gained within the studies to enhance the responsibility of environmentally friendly ways of

	Competences	the installation and planning process of wind farms and to support autonomously the implementation of an environmental impact study for a wind turbine.
	Total	24