

INTRODUCTION COURSE IN WIND ENERGY

(24 hours)

SECTION		TOPICS	DURATION-Hours
1. WIND ENERGY RESOURCES	1	Introduction to wind energy	2
		Content	Global challenges of climate change, solar radiation and wind energy, the need of wind energy for power generation, uses of wind energy in the past, wind potential in various locations.
		Knowledge	Basic knowledge on climate change, solar energy and creation of wind power, its potential for electricity generation, past uses of wind energy
		Skills	Ability to understand the problem of climate change, to perceive the necessity of renewable energy sources with emphasis on solar and wind power and to gain a basic understanding of wind energy engineering
		Competences	Ability to delve into simple issues of climate change and the technologies of solar and wind power and to identify with some autonomy the

			potential for renewable energy and specifically wind energy
	2	Wind resources	2
		Content	Atmospheric turbulence, energy content of the wind, relation of wind velocity and wind energy, change of wind speed with the height from the ground, change of the wind energy according the landscape, wind resources in Europe
		Knowledge	Basic knowledge on estimation of wind energy and its dependence from various parameters, relation of wind energy with the height and the landscape, wind potential in Europe
		Skills	Basic rules to estimate the energy of the wind and its dependence from various environmental parameters
		Competences	Ability to choose the most appropriate wind resource, depending on the circumstances given from the environmental factors of a specific area, such as the landscape and the wind speed with some autonomy.
	3	History of wind	2

		turbines	
		Content	Past uses of wind mills, use of wind energy for water pumping, evolution of wind turbines, modern on-shore and off-shore wind turbines.
		Knowledge	Basic 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 over time, evolution and the differences between on-shore and off-shore wind turbines.
		Competences	Ability 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 over time.
2. WIND TURBINES TECHNOLOGY & ECONOMICS	4	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	Basic Knowledge on 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 with basic rules and to realize its characteristic curve
		Competences	Ability to calculate specific parameters in order to succeed the highest possible generated energy, adjusting wind turbines plant and its electricity production with some autonomy
	5	Cost of wind farms	2
		Content	Phases in wind turbine creation, development-implementation-operation-decommissioning, cost components of a wind farm, Indicative costs of wind turbines and farms.
		Knowledge	Basic knowledge on separate stages in wind turbine development, capital cost of wind turbines
		Skills	Ability to estimate the capital cost of wind turbines with simple rules and tools
			Ability to conduct with some autonomy financial assessments for the cost of installing &

		Competences	running a wind farm and choose the most cost effective one
	6	Economics of wind farms	2
		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	Basic knowledge on how to estimate the energy generated by wind turbines, the revenues the costs and the profitability
		Skills	Ability to estimate costs, revenues and the profitability of a wind turbines using simple rules and tools
		Competences	Ability to conduct with some autonomy financial assessment for the viability of operating wind turbines, and making a cost-benefit analysis by choosing the most profitable one
3. TYPES, TECHNOLOGY AND	7	On-shore and off-shore wind turbines	2

MATERIALS OF WIND TURBINES			
		Content	Off-shore wind turbines and farms, requirements for off-shore wind turbines, foundation of turbines in the sea, maintenance.
		Knowledge	Basic knowledge on off-shore wind turbines, their requirements and their maintenance
		Skills	Ability to realize and understand the problems during wind turbine foundation
		Competences	Ability to carry out routine problems about turbine foundation, maintenance requirements for on-shore and off-shore turbines with some autonomy
	8.	Wind energy technology concepts-components of wind plants	2
		Content	Components of wind turbines, foundation, horizontal and vertical rotors
		Knowledge	Basic knowledge on the most important types of wind turbines, separate parts and components of wind turbines

		Skills	Ability to understand and recognize the wind energy technology basic concepts, characteristics & components plants and its use.
		Competences	Ability to suggest with some autonomy the most suitable components of wind plants.
	9	Materials requirements for wind turbine blades	2
		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	Basic knowledge on calculating the most important parameters influencing wind turbine life
		Skills	Ability to calculate the most important parameters in wind turbine operation using simple rules and tools
		Competences	Ability to suggest the most suitable material of wind turbine blades depending on the basic requirements and the simple calculations of technical parameters with some autonomy
4. SITING, CONTROL AND	10	Grid connection and control of wind	2

ENVIRONMENTAL IMPACTS OF WIND TUBINES		turbines and wind power plants	
		Content	Main electrical design concepts , main objectives of controlling wind turbines, pitch control and active staff control, maximum power point tracking, control architecture in wind power plants
		Knowledge	Basic knowledge on the most important designs in connecting wind turbines with the electric grid, controlling wind turbine plants and optimizing the generated power
		Skills	Ability to realize the different configurations for connecting into the grid and controlling wind turbines using simple rules and tools
		Competences	Ability to manage the control systems with some autonomy by selecting suitable designs for controlling wind turbines plants
	11	Siting of wind turbines and wind farms	2
		Content	Choosing the optimum site for installation of wind turbines, analysis of landscape and wind velocity data
			Basic knowledge on the most important

		Knowledge	methodologies for optimum sitting of wind turbines and farms
		Skills	Ability to find the optimum site for wind turbines installation using simple rules and tools
		Competences	Ability to choose the optimum site for wind turbines after analyzing with some autonomy basic concepts of landscape and wind velocity data
	12	Environmental impacts of wind farms	2
		Content	Environmental impacts during installation, operation and decommissioning, impacts on landscape, noise creation, impacts on birds life
		Knowledge	Basic knowledge on environmental problems and impacts during construction and operation of wind farms
		Skills	Ability to assess basic environmental problems during installation, operation and decommissioning of wind turbines
		Competences	Ability to draw upon the knowledge and the skills gained within the studies to find with some autonomy friendly ways of the installation and simple planning process of wind farms.

		Total	24
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