NAME:

TEST (5 points)

1	2	3	4	5	6	7	8	9	10
A	A	B	C	B	C	A	C	A	D

11	12	13	14	15
C	D	B	B	B

Multiple choice test (5 points) – Correct +1, incorrect -1/3, non-answered 0

1 In percentage of the total installed generation, installed capacity of wind turbines is higher than the wind electrical energy generated because of

a) the wind turbine capacity factor
b) the lower cost of nuclear power plants
c) the higher cost of nuclear power plants
d) the subsidies related to the energy sector

2 In a given wind turbine, how can we increase the capacity factor?

a) Installing longer blades for the same power rating
b) Installing shorter blades for the same power rating
c) Reducing the hub height and maintaining the same blade length and power rating
d) None of the previous answers

3 The Weibull distribution

a) is probability distribution which allows to predict the wind speed
b) is equivalent to the Rayleigh distribution taking k=2
c) has two parameters, c and k, where c is the mean wind speed and k is the shape factor
d) is used to calculate maximum power available in the wind

4 The wind shear explains why

a) wind turbines can be bigger in the southern hemisphere
b) wind turbines generate less at high altitude
c) the hub elevation influences the wind speed in the wind turbine
d) the terrain roughness is higher for offshore wind

5 Wind turbine classes are determined by three parameters. Which of the following is not one of them:

a) The average wind speed
b) The turbine nominal power
c) The wind extreme gust
d) The wind turbulence

6 In a wind turbine rated to 3 MW, we have a power generation of 500 kW with a wind speed of 6 m/s, what power will be generated with a wind speed of 12 m/s?

a) 1 MW
b) 2 MW
c) 3 MW
d) 4 MW

7 In a given project, the air density has been not considered properly and it is actually 10 % higher. The power available in the wind will be

a) 10 % higher
b) 10 % lower
c) higher, but less than 10 %
d) lower, but less than 10 %

8 In a given project, the air density has been not considered properly and it is actually 10 % higher. The annual energy production of a wind turbine in that location

a) will be 10 % higher
b) will be 10 % lower
c) will be higher, but less than 10 %
d) will be lower, but less than 10 %

9 The Betz limit is

a) 16/27
b) The maximum efficiency which can be achieved with a wind turbine of 3 blades
c) not dependent on the wind turbine speed
d) highly dependent on Reynolds number

10 In the operation of a wind turbine, the power coefficient Cp depends on

a) air density and hub height
b) hub height and tip speed ratio
c) hub height and pitch angle
d) tip speed ratio and pitch angle

11 Which of the following element is **not** present in all the types of horizontal axis wind turbines discussed in class

a) hub
b) transformer
c) gearbox
d) nacelle

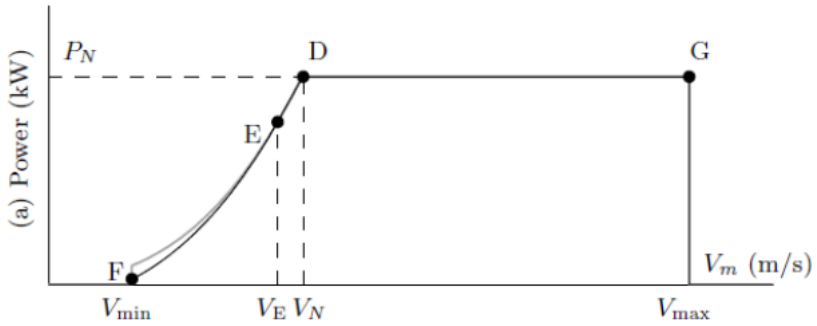
12 The power coefficient …

a) is constant for fixed-speed wind turbines
b) is constant for variable speed wind turbines
c) has to be maintained higher than 1 to extract power from the wind
d) is affected by the pitch angle when it is in power limitation mode

13 Fixed-speed wind turbines

a) are able to adapt the tip speed ratio when wind changes to extract the maximum available power
b) rotate at nearly constant speed even during wind speed changes
c) do not require gearbox
d) usually include a synchronous generator

14 In the following figure related to a fixed-speed wind turbine generator



a) The F point corresponds to the cut-out speed of the wind turbine
b) In the D-G sector the pitch system is limiting the power
c) V_E is the cut-in speed of the wind turbine
d) In the sector F-E the turbine is operating at nominal power

15 Variable speed type 4 wind turbines

a) always include a permanent magnet synchronous generator
b) include a full power converter to isolate the generator from the AC network
c) cannot increase the number of generator phases to more than three
d) have an AC connection between the rotor inductances and the AC network

Sketch the four types of wind turbines, indicating the main components which form each of them Comment on the main characteristics, advantages and drawbacks of each concept. (1 point)

Sketch the model you programmed in Simulink to analyze the dynamic behavior of a fix-speed wind turbine (1 pt)

Draw a Figure with the electrical and mechanical power in a fixed-speed wind turbine (for different wind speeds) and describe the procedure to calculate the steady-state wind turbine speed. (1 pt)

Sketch and explain the different possible system configurations for type 4 wind turbines (1 pt)

Sketch a general control diagram of a variable speed wind turbine and describe the main controllers and their functions (1 point)