

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, Dec 2021

Programme Name: M.Tech/ Electrical

Semester: III

Course Name : Wind Energy Technology

Time: 03 hrs.

Course Code : EPEC8008

Max. Marks: 100

Nos. of page(s) : 3

SECTION A

1. Each Question will carry 4 Marks

2. Instruction: Complete the statement / Select the correct answer(s).

S. No.	Question	CO
Q.1	<p>A. Wind turbines are mounted on tower due to which of the following reasons:</p> <ul style="list-style-type: none">a) It is cheaper to installb) It eases maintenancec) Wind speed increases with heightd) None of these <p>B. Which of the following statistical distribution describing wind data with most accuracy:</p> <ul style="list-style-type: none">(a) Normal distribution(b) Poisson's distribution(c) Weibull distribution(d) None of these	CO1
Q 2	<p>A. The maximum power extracted by a wind turbine varies with diameter D and wind velocity as:</p> <ul style="list-style-type: none">a) $D^2V^{8/3}$b) D^2V^3c) $D^3V^{9/4}$d) $D^3V^{8/3}$ <p>B. A Wind turbine has a rotor diameter of 60 m. It is operating at a location having wind speed of 35 Kmph and rotating at 20 rpm. If the power produced by machine is 895Kw. Calculate the coefficient of performance.</p> <ul style="list-style-type: none">a) 0.57b) 0.47c) 0.67d) 0.87	CO2

Q 3	<p>Define the following terms with reference to wind energy:</p> <p>a) Annual Energy Production(AEP) b) Simple Payback Time c) Net Present Value d) Levelized Cost of Energy</p>	CO5
Q 4	<p>State true or false for the followings:</p> <p>a) Windmills typically capture all of the energy in the wind as long as the wind speeds are more than 20 kmph. T/F</p> <p>b) Windmill shaft can be connected to the generator without a gear. T/F</p> <p>c) Windmills produce considerable noise pollution. Hence, normally windmills are set up to a distance from the civilization area." The above statement is. T/F</p> <p>d) For a given velocity far away from and after the windmill the Betz limit is constant regardless of the velocity of the incoming wind. T/F</p>	CO2
Q 5	<p>A. A wind turbine with a rotor diameter of 80 m has maximum power coefficient for tip speed ratio 8.8. What is the relation between wind speed V and wind turbine rotational speed ω when the wind turbine operates with maximum power point tracking?</p> <p>a) $V=0.11 \omega$ b) $\omega= 0.11V$ c) $V=0.22 \omega$ d) $\omega= 0.22V$</p> <p>B. The maximum power coefficient is 0.42 for the wind turbine with a rotor diameter of 80 m. The air density is 1.225 kg/m³. If the losses are neglected, what would the maximum power be at 7 m/s wind speed?</p> <p>a) 666 kW b) 444 kW c) 333 kW d) 888 kW</p>	CO3
<p>SECTION B</p> <p>1. Each question will carry 10 marks 2. Instruction: Write short / brief notes</p>		
Q 6	<p>Wind power plants are classified based upon the various criteria, discuss these and illustrate the types of wind power plants be mentioning their key features.</p>	CO1
Q 7	<p>I. With reference to wind energy, draw the power curve and define the following terms.</p> <p>a) Rated wind speed b) Cut in speed c) Cut off speed d) Furling e) Bet'z Limit</p> <p>II. List the name of any five wind power plant manufacturers and available wind farms in India.</p>	CO2

Q 8	<p>I. Illustrate all the development phases of a wind farm and highlight their characteristics and functions in every phase.</p> <p>II. Discuss the environmental impact of wind farms. How do we access this impact and takes all these in consideration.</p>	CO5
Q 9	<p>Describe the generator models used in wind energy. Draw the schematic and highlight the characteristics.</p> <p style="text-align: center;">OR</p> <p>While harnessing the power from wind and integrate it to the grid certain power quality issues are observed. Present the detailed analysis of such power quality issues in wind power when it is integrated to the grid.</p>	CO4
<p>Section C</p> <p>1. Each Question carries 20 Marks.</p> <p>2. Instruction: Write long answer.</p>		
Q 10	<p>I. Design the layout of electrical connection of wind power plant considering wind turbines as a node in connection, highlight the point of connection.</p> <p>II. Design the control architecture of wind farms, mention all the components and describe the control strategies.</p>	CO4
Q 11	<p>I. A WPP has a rotor diameter of 80 m. The RPM is 14 and wind speed is 8 m/s. The power coefficient is 0.45. Assuming the air density as 1.226 kg/m³, find the torque coefficient. Also, determine the torque available at the rotor shaft.</p> <p>II. A WPP of 40 m rotor diameter is rotating at a particular windy site with the average wind speed of 6 m/s at a power coefficient of 0.4. Assuming the air temperature as 25°C with a density of 1.225 kg/m³, calculate the (a) total power available in the wind, (b) maximum power density, (c) actual power density, and (d) power output from the WPP.</p> <p>III. For a wind power plant the minimum rotational speed of the generator is 900 rpm (rotations per minute) What is the value of minimum rotational speed in rad/s?</p> <p style="text-align: center;">OR</p> <p>The requirement of a village/community is 20,00,000 kWh. If the choice is for a three-bladed, upwind, horizontal axis, geared, onshore, tubular type WPP, determine the rating of the WPP to meet this energy requirement, as well as the estimated costs. Given that the power coefficient is 0.4, wind speed at 90 m hub height is 8 m/s, air density is 1.225 kg/m³, PLF is 0.3, number of hours in a year is 8760 and cost per megawatt of a WPP is 60000000 (6 crores).</p>	CO3