

Roll No. 7055.....

Total Pages : 4

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May 2023

B.Tech. (EL) VI SEMESTER

Wind and Solar Energy Systems (ELPE614)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. / (a) Discuss the concept of a solar pond? CO2 (1.5)
- 0 (b) What are the two primary aerodynamic forces acting on wind turbine rotors? CO1 (1.5)
- 0 (c) Define 'concentration ratio' in solar thermal systems. CO2 (1.5)
- (d) What is the function of glass cover in flat plate collectors? CO1 (1.5)
- X (e) What do you understand by power quality? CO3 (1.5)
- _(f) Discuss the advantages of HAWT over a VAWT. CO2 (1.5)

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- ✓(g) What is 'cut in speed'? CO2 (1.5)
- ✓(h) What do you understand by upwind and downwind turbine? CO2 (1.5)
- (i) Find the fill factor of a solar cell for the following data:
 $P_{\max} = 20 \text{ W}$, $V_{\text{oc}} = 18 \text{ V}$, $I_{\text{sc}} = 4 \text{ A}$. CO1 (1.5)
- ✓(j) Why is it necessary to have an optimal tip speed ratio (TSR)? CO3 (1.5)

PART-B

2. ✓(a) Discuss fixed speed and variable speed wind turbine. Also explain Doubly-fed induction generator-based system (with neat diagram) CO1 (7.5)
- ✓(b) Discuss the concept of Maximum Power Point Tracking (MPPT). Discuss any *one* MPPT algorithm along with the flow chart. CO3 (7.5)
3. ✓(a) List the various components of a wind turbine system and discuss the function of each. Also discuss in detail, the types of wind turbine with neat diagram and examples. CO2 (7.5)
- ✓(b) Using Betz model of wind turbine, derive the expression for power extracted from wind. What is the maximum theoretical power that can be extracted? CO2 (7.5)
4. (a) What do you understand by the 'islanded mode'? Discuss are the various grid integration and power quality issues encountered in wind and solar energy systems. CO2 (7.5)

- (b) Following data is measured for a HAWT : CO2 (7.5)
Speed of wind : 25 m/s at 1 atm and 27°C
Diameter of rotor = 75 m
Speed of rotor = 50 rpm
Calculate the torque produced at the shaft for maximum output of the turbine.
5. (a) With the help of a neat sketch, define the following :
CO2 [7.5]
- (i) Hour Angle.
 - (ii) Surface azimuth angle.
 - (iii) Angle of latitude.
 - (iv) Inclination angle.
 - (v) Zenith angle.
- (b) With the help of a neat sketch, explain the construction and working of a photovoltaic cell. Also discuss the P-V and I-V characteristics of a PV cell. CO2 (7.5)
6. (a) Classify different types of solar thermal collectors. Discuss the working and construction details of a flat plate collector with a neat diagram. Also explain the principal disadvantage of flat plate collectors.
CO2 (10)
- (b) For a city located at 80.50 longitudes, calculate the solar time on March 15, 2011 at 10:30 am IST. CO2 (5)

7. (a) A three-bladed wind rotor with blade length of 52 m is operating in a wind stream having wind velocity of 12 m/s. Air density is 1.233 kg/m^3 and power coefficient may be taken as 0.4. Calculate the extractable power from the wind. CO1(5)
- (b) Draw a comparison between various solar photovoltaic technologies with the help of neat diagram. CO2 (5)
- (c) Discuss the design considerations of a boost converter used in a PV based system. CO3 (5)
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