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15EE654

Sixth Semester B.E. Degree Examination, June/July 2018
Solar and Wind Energy

Time: 3 hrs.   Max. Marks: 80

Note: *Answer any FIVE full questions, choosing one full question from each module.*

Module-1

1   a. What are the advantages and limitations of non – conventional energy sources?   **(04 Marks)**
    b. Explain the following terms : i) Energy Policy   ii) Energy Planning   iii) Energy Management   iv) Energy Audit   v) Energy Conservation and   vi) Energy Efficiency.   **(06 Marks)**
    c. Under what circumstances storage of energy becomes necessary? Explain the different specifications of energy storage devices on the basis of which finer selection of storage technology is made.   **(06 Marks)**

OR

2   a. Enumerate the criteria based on which energy sources are classified. Briefly explain any two classifications with examples.   **(06 Marks)**
    b. Explain the three phases involved in carrying out detailed energy audit.   **(04 Marks)**
    c. With schematic representation, explain the mechanism of absorption , scattering , beam and diffuse radiation received at earth surface.   **(06 Marks)**

Module-2

3   a. Define the following with respect to solar radiation :   **(06 Marks)**
       i) Declination Angle   ii) Zenith Angle and   iii) Hour Angle.
    b. With a neat diagram, explain the Trombe Wall method of solar passive space heating.   **(04 Marks)**
    c. Calculate the monthly average hourly radiation falling on a flat plate collector facing south ($\gamma = 0^0$) with a slope of 10^0, given the following data :
       Location : Trivandrum (8.48^0N) ;   Month : October ;
       Time : 1300 to 1400 hours ; $\bar{I}_g = 2508$ kJ/m^2-h   ; $\bar{I}_d = 1073$ kJ/m^2-h.
       Assume ground reflectivity to be 0.23.   **(06 Marks)**

OR

4   a. Explain with a neat diagram, the principle of conversion of solar energy into heat employed in liquid flat plate collectors.   **(06 Marks)**
    b. Explain the working principle of a pyranometer with the aid of a neat sketch.   **(05 Marks)**
    c. For New Delhi (28^0 35' N, 77^0 12' E), calculate the solar time and solar day length on 20 Feb 2015 at 02:30pm IST. The equation of time of correction on 20 Feb 2015 is -14.283 min. The standard IST longitude for India is 81^0 44' E.   **(05 Marks)**

Module-3

5   a. What are the major advantages and disadvantages of a solar PV system?   **(04 Marks)**
    b. Describe the working principle of a solar PV cell. With the help of a block diagram, explain the working of a grid tied solar PV system.   **(08 Marks)**
    c. Define : i) Fill factor and   ii) Conversion efficiency.   **(04 Marks)**

OR

6 a. Describe the classification of solar cells based on the type of active material used. **(08 Marks)**

b. List various applications of solar PV system. **(02 Marks)**

c. A PV system feeds a dc motor to produce 1 HP power at the shaft. The motor efficiency is 85%. Each module has 36 multi crystalline silicon solar cells arranged in 9×4 matrix. The cell size is 125mm $\times$ 125mm and cell efficiency is 12%. Calculate the number of modules required in the PV array. Assume global radiation incident normally to the panel as $1kW/m^2$. Take 1HP = 746W. **(06 Marks)**

Module-4

7 a. Describe the main considerations in selecting a site for wind generators. **(06 Marks)**

b. Comment on the environmental impacts of wind energy. **(04 Marks)**

c. Wind at a velocity of 20m/s flows through a horizontal axis wind turbine having a diameter of 10m. Calculate i) Total power available in wind , ii) Maximum power which can be extracted and iii) Torque at maximum efficiency if rotor speed is 30 rpm. **(06 Marks)** Assume $\rho = 1.293$ kg/m^3 and $g_c = 1$.

OR

8 a. With the help of a diagram, explain the terms lift force and drag force. **(04 Marks)**

b. Explain the factors that influence the wind energy economics. **(04 Marks)**

c. With usual notations, derive an expression for the maximum power output of a horizontal axis wind turbine. **(08 Marks)**

Module-5

9 a. What are the advantages and disadvantages of wind energy conversion system? **(04 Marks)**

b. Compare horizontal and vertical axis wind turbines. **(04 Marks)**

c. Explain the two following applications of wind energy :
i) Pumping applications and ii) Electric generation applications. **(08 Marks)**

OR

10 a. Derive the relationship between the torque coefficient C_T, power coefficient C_p and the tip speed ration λ. **(08 Marks)**

b. Sketch the diagram of a horizontal axis wind turbine (HAWT) and explain the functions of its main components. **(08 Marks)**

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