

CBCS SCHEME

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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 ($\gamma = 0^\circ$) with a slope of 10° , given the following data :
Location : Trivandrum (8.48°N) ; Month : October ;
Time : 1300 to 1400 hours ; $\bar{I}_g = 2508 \text{ kJ/m}^2\text{-h}$; $\bar{I}_d = 1073 \text{ kJ/m}^2\text{-h}$.
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 ($28^\circ 35' \text{N}$, $77^\circ 12' \text{E}$), 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 $81^\circ 44' \text{E}$. (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 $125\text{mm} \times 125\text{mm}$ 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 $1\text{HP} = 746\text{W}$. (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 $\rho = 1.293\text{ kg/m}^3$ 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 : (08 Marks)
 i) Pumping applications and ii) Electric generation applications.

OR

- 10 a. Derive the relationship between the torque coefficient C_T , power coefficient C_p and the tip speed ratio 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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