Eighth Semester Examination – 2008

RENEWABLE ENERGY SOURCES AND APPLICATIONS

Full Marks – 70

Time : 3 Hours

Answer Question No. **1** *which is compulsory and any* **five** *from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2 ×10

    (a) What do you mean by "Energy Yield Ratio" ?

    (b) Write a short note on the common forms of energy.

    (c) What is 'Beam radiation', 'Diffuse radiation', 'Air mass' and 'Global radiation' ?

    (d) What is 'energy storage' and why is it necessary ?

    (e) Write a note on variation of wind speed with height.

    (f) What are the limitations of Tidal Energy ?

    (g) Write a short note on 'wave devices'.

    (h) Write about the various applications of fuel cell.

    (i) Comment on use of Hydrogen as energy carrier.

    (j) Write a short note on 'Bio-Diesel'.

2. (a) Explain the working of the instruments required for the collection of solar radiation data.   4

    (b) Calculate the angle of incidence on a horizontal plane surface at Cuttack at 12:50 Hrs (1st), on March 21, in a leap year. The longitude and latitude of Cuttack are 85°54′E and 20°28′N respec-

tively. The standard longitude of 1st is 81°44'E. 6

The following formula, having their usual connotations, may be used :

(i) $B = \dfrac{360}{364} (n - 81)$

(ii) $E = 9.87 \sin 2B - 7.53 \cos B - 1.5 \sin B$

(iii) Solar time = Standard time $\pm (L_{st} - L_{loc}) + E$

(iv) $\omega = [\text{Solar time} - 12.00] \text{ hrs} \times 15°$

(v) $\delta = 23.45 \times \sin [\dfrac{360}{365} (284 + n)]$

(vi) $\cos \theta_i = [\cos\phi.\cos\beta + \sin\phi.\sin\beta.\cos\gamma].$
$\cos\delta.\cos\omega + \cos\delta.\sin\omega.\sin\beta.\sin\gamma + \sin\delta$
$[\sin\phi.\cos\beta - \cos\phi.\sin\beta.\cos\gamma].$

3. On what basis energy storage systems are classified ? Can energy available in one form be stored in another form ? Explain briefly.

10

4. (a) Explain the terms 'Beanfort scale' and 'wind rose'. 4

(b) A HAWT has the following data :

Speed of free wind at a height of 10 m = 14 m/s

Pressure is 1 std atmosphere i.e., 1.01325×10^5 Pa

Ambient temperature is 15°C

For air, the gas constant R = 287 J/kgk

$\alpha = 0.13$

Height of tower = 110 m

Diameter of rotor = 85 m

Downstream wind velocity is 0.45 times that of upstream wind

Find :

(i) Power available in the wind

(ii) Power extracted by the turbine

(iii) Axial force on the turbine

(iv) Axial force on the turbine

    (a) When maximum power is extracted, and

    (b) When the blade stalls completely and no power is extracted.   6

5. (a) Write a note on origin and nature of Tidal Energy.   4

  (b) Derive an expression for Tidal power generation potential with single filling or emptying of a basin.   6

6. Show that power in waves is directly proportional to the square of amplitude and to the period of wave for ocean waves.   10

7. Describe the various classifications of fuel cells.   10

8. What are the various Bio-mass conversion technologies presently used ?   10

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