Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PEEL 5302

Fifth Semester Examination – 2013

RENEWABLE ENERGY SYSTEMS

BRANCH : ELECTRICAL, EEE

QUESTION CODE : C- 424

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 is cogeneration ? Explain with an example.

   (b) What is dispersed generation and what is its importance ?

   (c) Define solar constant and declination.

   (d) For a parabolic collector of length 2 m, the angle of acceptance is 15°, find the concentration ratio of the collector.

   (e) What is fill factor ? What is its significance in selecting a PV module ?

   (f) What is dark saturation current in a semiconductor PV cell and mention its significance.

   (g) Draw and label an airfoil of the blade of a WECS.

   (h) Explain the design specialty of an air foil to produce a higher lift force.

   (i) What is pyrolysis and what type of biomass conversion technology it comes under ?

   (j) What is the need of a hybrid system and give examples of various type of hybrid combinations.

P.T.O.

2. (a) How the various conventional energy generations have affected the environment and the terrestrial ecology ? Discuss, in detail. 4

(b) Draw the equivalent circuit for a semiconductor PV cell, signify the presence of each component in it and derive the equation for V_{oc}. 6

3. (a) How the quality of a PV cell is measured ? What are the limitations to the efficiency of a PV cell ? 5

(b) A solar cell (0.9 cm^2) receives solar radiation with photons of 1.8 eV energy having an intensity of 0.9 mW/cm^2. Measurements show open-circuit voltage of 0.6 V/cm^2, short-circuit current of 10 mA/cm^2, and the maximum current is 50% of the short-circuit current. The efficiency of cell is 25%. Calculate the maximum voltage that the cell can give and find the fill factor. 5

4. (a) What is the maximum power point of a PV cell and how the tracking of the maximum power point is done ? Explain, in detail. 5

(b) Estimate τ_a, τ_p, and τ for a glass cover system with given data : Angle of incidence = 10°; No. of covers = 4; Thickness of each cover = 3 mm; Refractive index of glass relative to air = 1.52; Extinction coefficient of glass = 15 m^{-1}. 5

5. (a) Explain the aerodynamics operation in a wind turbine ? Taking a Darrius rotor justify the resultant rotational force developed on the blade is unidirectional. Use suitable vector diagrams to explain. 5

(b) Wind speed is 10 m/s at the standard atmospheric pressure. Calculate :

(i) The total power in wind stream.

(ii) The total power produced by a turbine of 100 m diameter with an efficiency of 40%.

Given that: Air density = 1.226 J/kg.K/m^3. 5

6. (a) What is Betz limit for a WECS? Establish a relation between $C_{p\max}$, $C_{\tau\max}$ and TSR. 5

(b) Design the rotor radius for multiblade wind turbine that operates in a wind speed of 3 kmph to pump water at a rate of 6 m^3/h with it a lift of 6 m. Also calculate the angular velocity of the rotor. Given that: water density = 1000 kg/m^3, g = 9.8 m/s, water pump efficiency = 50%, efficiency of rotor to pump = 80%, $C_p = 0.3$, $\lambda = 1.0$, air density = 1.2 kg/m^3. 5

7. (a) What is gasification ? What are the chemical reactions takes place during gasification ? Describe how the down draft type of gasifier operates with its complete labelled diagram. 6

(b) Calculate the volume of a fixed doe type biogas digester for output of two cows. Also calculate the thermal power available from biogas. Use the following data : 4

Retention period = 40 days

Dry matter produced = 2 kg/day/cow

Biogas yield = 0.22 m^3/kg of dry matter

Percentage of dry matter in cow dung = 18%

Density of slurry = 1090 kg/m^3

Burner efficiency = 60%

Heating value of biogas = 23 MJ/m^3

8. Write short notes on any **two** of the following : 5×2

(a) Performance analysis of Compound parabolic Concentrator

(b) Wind-Pv hybrid system

(c) Classification of solar cells

(d) Peltier Cooling.