BITS Pilani, Dubai Campus

FIRST SEMESTER 2013- 2014

IV ALL BITS C462 Renewable Energy Compre Examination Date: 29.12.13

Weightage: 40% Marks: 80 Time: 3 hours

Answer ALL the questions

1. (a) Explain latitude, declination angle and surface azimuth angle [3]

(b) Estimate the average daily global radiation on a horizontal surface at Baroda (22^0 N, 73^0 0' E) during the month of March if the average sunshine hour per day is 9.5. Assume a = 0.28 and b = 0.48. [7]

2.(a) Explain latent heat storage for storing solar thermal energy with examples [2]

(b) Data for a Flat plate collector used for heating are given below: [8]

FACTOR	SPECIFICATION
Location & Latitude	BARODA, $22^0\ 00^1$ N
Day & time	Jan 1 , 11.30- 12.30(IST)
Average Intensity of solar radiation	350 W/m^2
Collector tilt	Latitude + 15^0
No.of glass cover	2
Heat removal factor for collector	0.810
Effective Transmittance Absorptance product	0.811
Top loss coefficient(U_L) for collector	7.88 W/m^2 ^{0}C
Collector fluid temperature	60^0C
Ambient temperature	15^0C

Calculate

(i) Solar altitude angle (ii) Incident angle and (iii) Collector efficiency

3.(a) What are the parameters should be considered while selecting a wind mill? [3]

(b)The following data were measured for wind turbine:

The speed of wind = 20 m/s at 1 atm, 27 ^{0} C

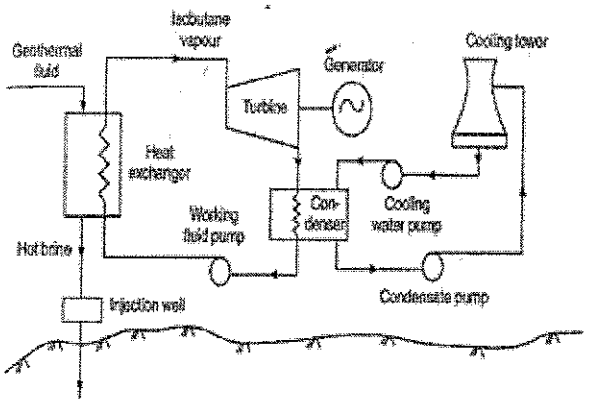
Diameter of rotor = 80 m

Speed of rotor = 40 rpm

Calculate the torque produced at the shaft for maximum output of the turbine. [7]

4 (a) Briefly explain why single flash type geothermal power plant is less efficient than double flash system. [2]

(b) A binary fluid (water/isobutene) geothermal thermal power plant uses geothermal water at 148 ^{0} C and leaves at 70 ^{0}C in the heat exchanger as shown in Fig. The isobutene at turbine inlet condition is 120 ^{0}C, dry saturated and flow rate is 100 kg/s. Feed pump internal work is -9.55 kJ/kg. The isobutene leaves the condenser as saturated liquid at 0.4 MPa. Mechanical efficiency of turbine is 0.98 and electrical efficiency of generator is 0.95. Calculate (i) geothermal water flow rate and (ii) electrical power output. Assume the enthalpy of isobutene leaves the turbine is 579.88 kJ/kg. [8]



Properties for Isobutane:

At pressure 0.4 MPa, h_f = 228.85 kJ/kg and h_g = 3200.35 kJ/kg

At 120 ^{0}C, h_f = 50 kJ/kg and h_g = 655.01 kJ/kg

Properties for Water:

At 148 ^{0}C, h_f = 623.22 kJ/kg and h_g = 8021.01 kJ/kg

At 70 ^{0}C, h_f = 292.82 kJ/kg and h_g = 3852.56 kJ/kg

5.(a)Derive the theoretical power generated in double cycle of tidal power plant is 450 AR^2 kW, where A is area of the basin in m^2 and R is the range of the tide in m. [4]

(b)For the basin area of a tidal project is 0.82 sq. km, with a difference of 6.5 m between the high and low water levels. The system generates eclectic power for 4 hours in each cycle and yearly power output is 340 x 10^5 kWh. Calculate the power in kW at any point of time and average available head. Assume the overall efficiency as 0.82 and the density of sea water is 1025 kg/m^3 [6]

6.(a) Briefly explain the production of ethanol from biomass. [3]

(b)A small industry in a remote place has the following energy requirements: (i) 25 bulbs that operate for 8 hours daily (ii) 6 computers each of 250 W that operates six hours daily by a dual fuel-engine driven generator (iii) 2 hp water pump driven by duel fuel engine for two hours daily. Calculate the total daily requirement of biogas, volume of the biogas plant for the retention time is 50 days and number cows required to feed the plant.

Assume the following: (i) cow dung production rate is 10 kg per day and only 70 % of the cow dung produced can be collected (ii) solid matter in the cow dung is about 20 % (iii) Biogas required for a bulb is 0.126 m^3/hour (iv) the density of slurry is 1090 kg/m^3 ,(v) heating value of the bio gas is 23 MJ/ m^3 and (vi) gas yield is 0.34 m^3 per kg of dry mass. [7]

7. (a) Explain the working principle of an alkaline fuel cell with sketch. [4]

(b) A H_2-O_2 fuel cell operates at 25 ^{0}C. Calculate the voltage output of the fuel cell , the efficiency and the electric work output per mole of H_2 consumed and per mole of H_2O produced .Also compute the heat transferred to the surroundings. Given $\Delta H_{25}{}^0{}_C$ = - 285.83 kJ/ kg-mole and $\Delta G_{25}{}^0{}_C$ = - 237.14 kJl/ kg-mole . [6]

8. (a) What are the impact of solar energy generation on the environment? [3]

(b) Briefly explain the different methods of passive solar heating. [3]

(c) Briefly explain working of reaction turbine and Impulse turbine with example [4]

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First Semester 2013 - 2014
Course: BITS C462 RENEWABLE ENERGY
Test- 1[Closed book]

Max.Marks :25
Weightage: 25 %

Date:13.10.2013
Time: 50 min

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1. Calculate the hourly total radiation for a flt plate collector installed at a site where the latitude is 26 ^{0} 50'. The date is 30 June and time is 2 pm. The collector surface is tilted at an angle of 20 ^{0} from the ground and facing due south. The hourly total radiation on horizontal plane is 2.5 MJ/m^2/hr, the hourly diffuse radiation is 0.4 and ground reflectivity is 0.2. (7 Marks)

2. Data for a cylindrical parabolic collector used for heating are given below:

   Intensity beam radiation (I_bR_b) : 700 W/m^2
   Useful heat gain : 6477.5 W
   Absoptivity , ρ = 0.85
   Trasmissivity τ = 0.93 and ($\tau\alpha$) = 0.78
   Width of concentrator: 2.5 m
   Outside diameter of absorber tube: 6.5 cm
   Temperature of fluid to be heated: 150 ^{0}C
   Ambient temperature: 28 ^{0}C
   Heat loss coefficient: 7 W/m^2 ^{0}C
   Specific heat of water: 1.163 Wh/kg ^{0}C

   Find (a) absorbed radiation flux (b) length of cylindrical parabolic collector and (c) mass flow rate of water (6 Marks)

3. (a) Define Solar azimuth angle (3x2 Marks)
   (b) Briefly explain the working principle of solar pond power plant.
   (c) What is the importance of selective surfaces?

4. A solar distillation plant with rectangular glass plate of size 10 m x 8 m which receives average solar radiation of 800 Wh/m^2-day. The efficiency of the plant is 39 %. If the cost of 1 liter of distilled water is Rs 11 and cost of the plant is Rs 2,00,000, calculate the payback period. Assume enthalpy of steam as 2675 kJ/kg and enthalpy of water as 415 kJ/kg. (6 Marks)

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First Semester 2013 - 2014

Course: BITS C462 Renewable Energy **A**

QUIZ- 2[Closed book]

Max.Marks :7 **Date:08.12.2013**
Weightage: 7 % **Time: 20 min**

Note: (i) Answer all the Questions.
(ii) Assume suitable value if required
(iii) Show the calculation steps

1. Find the solar radiation intensity at surface of sea, if the solar radiation intensity at 10 m depth of sea is 67.36 W/m^2 and at 20 m depth of sea is 3.35 W/m^2 respectively. [1]

2. What is the function of flash separator and purpose of water from deep sea in open cycle? [1]

3. Write the main parts in Francis turbine. [1]

4. What is the force exerted by the jet on a vertical plate, if the diameter of the jet is 50 mm and velocity of water is 40 m/s? [1]

5. What is the significance of specific speed in a turbine? [1]

6. A tidal power plant, with basin area of 0.8 km^2 and available head of water 6 m, generates electrical power of 50,000 kWh per tidal cycle. Calculate average discharge and difference of high and low water levels. Assume the this power plant, operates 4 hours in a cycle [2]

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First Semester 2013 - 2014

Course: BITS C462 Renewable Energy

A

QUIZ- 1[Closed book]

Max.Marks :8
Weightage: 8 %

Date:29.09.2013
Time: 20 min

Note: ***(i) Answer all the Questions.***
(ii) Assume suitable value if required

1. Differentiate very briefly between coal-fired thermal plant and integrated gasification combined cycle power plant.

2. What are the pollutants of oxides of nitrogen and how is the emission of NOx reduced?

3. What are the main environmental concerns of geothermal energy

4. Calculate the air mass (AM), when the zenith angle is 75^0.

5. Calculate the altitude angle for solar noon on Nov 3, 2003 in Delhi (latitude: 28^0)?

6. Write the expression for tilt factor for beam radiation.

7. Define the term: Global radiation.

8. Calculate the tilt factor for reflected radiation for a collector having slope of 12^0 and reflectivity of 0.25 .