

BITS, PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
IV Year II Semester - 2010-2011
Course: BITS C462 RENEWABLE ENERGY
COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80

Date: 1-06-2011

Weightage: 40 %

Time: 3 hours

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- Note:** (i) Answer **Part A & B** in separate booklets.
(ii) Thermodynamics tables are permitted
(iii) Draw neat sketches wherever necessary
(iv) Assume suitable data wherever necessary
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PART A

1a) A solar panel system installed in the southern hemisphere should be mounted such that it faces towards the north. Why? **[2 Marks]**

b) Calculate the **Useful gain**, **Exit fluid temperature** and **Collector efficiency** for a cylindrical parabolic concentrator system of 2 m width and 8 m length. The absorbing cylinder has the diameter of 6 cm and the transparent cover has a diameter of 9 cm.

Optical properties are estimated as $\rho = 0.85$, $(\zeta, \alpha) = 0.77$, $\gamma = 0.94$

Heat transfer coefficient from fluid inside to surroundings, $U_0 = 6.04 \text{ W/m}^2\text{°C}$

Heat transfer coefficient from absorber cover surface to surroundings, $U_L = 6.98 \text{ W/m}^2\text{°C}$

The incident beam radiation on the aperture of the collector is 698 W/m^2 and the ambient temperature is 25 °C . The collector is designed to heat a fluid entering the absorber at 150 °C at a flow rate of 400 kg/hr .

The fluid has $C_p = 1.256 \text{ kJ/kg °C}$. the heat removal factor is 0.8329

[8 Marks]

2a) Explain Bio mass conversion

[3 Marks]

b) Design a Bio gas system for a family of six members. The system design includes the estimation of total gas required, amount of dung required and the number of animals required to have feed stock of a given amount and the dimension of the digester

The following data are made for the design:

- About 350-450 litres of biogas required per day per person for cooking
- Average production of dung per animal per day.

Cow- 10 kg/day

Bullock- 15 kg/day

- Average gas production from dung is about 40 litres / kg of fresh dung
- Retention time of dung slurry in digester is 50 days,
- Density of the slurry = 1090 kg/m³

[7 Marks]

3a) For a thermoelectric power generators following parameters are given:

Temperature of the hot reservoir of source = 600^oK

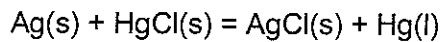
Temperature of the sink = 300^oK

Figure of merit for the material $Z = 2 \times 10^{-3} / K$

Determine the efficiency of the thermoelectric generation. What will be its Carnot efficiency?

[5 Marks]

b). A galvanic cell has the following reaction,



If $E_{25^{\circ}\text{C}} = 0.0455$ volt, and $(dE/dT) = 0.000338$ volt/degree,

Calculate ΔG , ΔS and ΔH

[5 Marks]

- 4) Write short Notes on:
- Manufacture of Ethanol
 - PV system
 - Molten Carbonate Fuel Cell
 - Peltier Effect

[2.5x4=10 Marks]

PART B

5.a. What are wind energy collectors? Give comparison study of vertical axis of wind mills.

[4 Marks]

b. A wind mill with 3 blade rotor lifts 3.05 m³/hour of water through a head of 25 m when the wind speed is 2.4 m/s. If the width of the blade is 30 cm and solidity is 0.025, calculate the power coefficient. Assume the following:

Transmission efficiency 85%

Pump efficiency 70%

Specific gravity of water 0.988

Specific gravity of air 1.222×10^{-3}

[8 Marks]

6.a Describe the working principle of total flow concept of geothermal plant with T-s diagram.

Compare it with other liquid dominated systems.

[6 Marks]

b. A hot water geothermal plant of the total flow type receives water at 225 ° C. The pressure at turbine inlet is 1.0 MPa. The plant uses direct contact condenser that operates at 0.05 MPa. The turbine has efficiency of 85% . For cycle output of 20 MW, calculate the hot water flow rate in kg/hour and plant efficiency. **[6 Marks]**

7. a. Explain the limitations of OTEC power plant. **[3 Marks]**

b. "The heat exchanger (evaporator) and condenser are the major components in a closed OTEC cycle" Comment on this statement

[3 Marks]

c. Describe the efforts made to improve the design of heat exchangers suitable for closed OTEC Cycle. **[4 Marks]**

8. Write short notes of the following:

[3x2=6 Marks]

a. Heliostats and its losses

b. Betz Coefficient

c. Hydrothermal geothermal sources

BITS PILANI, DUBAI CAMPUS
INTERNATIONAL ACADEMIC CITY, DUBAI
SECOND SEMESTER 2010-2011
FINAL YEAR ELECTIVE (ALL BRANCHES)
RENEWABLE ENERGY BITS C462

TEST – II (OPEN BOOK)

Date: 10-04-2011; Duration: 50 min.; Maximum Marks: 40, Weightage 20%

Notes:

1. *Answer all the questions*
 2. ***Hand written Note books and Text book are permitted***
 3. *Assume any missing data suitably and mention the same at appropriate place in your answer*
 4. *Draw neat sketches wherever necessary*
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Q.1. Design a Bio Gas system to be installed in a Village consisting of 80 families, each family consisting of seven members (5Adults and two children). The system design includes the Estimation of total gas required, Amount of feed stock (dung) required, Number of animals required to have feedstock of a given amount (Here assume that either cows or Bullock or Buffalo only) and Dimensions of the digester:-

Following assumptions are made for the design:

- About 400-450 litres of biogas required per day per person for cooking
- Average production of dung per animal per day:

Cow 10 kg/day

Bullock 14 kg/day

Buffalo 15 kg/day

(Select only one type of animals from the above)

- 1000 litres of gas is equivalent to 1 m³ of gas
- No. of digester = 3
- Average gas production from dung is about 42 litres / kg of fresh dung
(it is same in both summer and winter)
- Retention period of dung slurry in digester is 30 days

[15Marks]

Q.2.A. A wind turbine with solidity 0.05 which has much higher power coefficient and maximum efficiency of 60 %. The mean breadth of each blade is 0.5 meter. The turbine operates at 55 rpm. Wind at 1 standard atmospheric pressure and 20°C has velocity of 21 m/s. Calculate (i) maximum power density, (ii) torque at maximum efficiency and (iii) maximum axial thrust. **[8Marks]**

B. Show that the optimum exit velocity from the turbine blade is one-third of the inlet wind velocity **[5 Marks]**

Q 3.A. Compare the following systems:

(i) Hydrothermal system

(ii) HDR system **[5 Marks]**

B. In a vapor dominated hydrothermal power plant, 1000 kg / hour of saturated steam is throttled to a lower pressure before it enters the turbine. The steam conditions are 2.5 MPa, 300 °C and the turbine exhaust pressure is 15 kPa. Assuming the expansion inside the turbine is isentropic process and efficiency is 100 %, calculate (i) actual work output of the turbine and (ii) the condition of pressure and temperature of the steam for 70 % of actual work output of the turbine

[7Marks]

BITS PILANI, DUBAI CAMPUS, INTERNATIONAL ACADEMIC CITY, DUBAI
SECOND SEMESTER 2010-2011
IV YEAR ELECTIVE - I (ALL BRANCHES)
BITS C462 RENEWABLE ENERGY

TEST – 1(CLOSED BOOK)

Date: 20-02-2011; Duration: 50 min.; Maximum Marks: 50, Weightage 25%

Notes:

1. Answer all the questions
2. Assume any missing data suitably and mention the same at appropriate place in your answer
3. Draw neat sketches wherever necessary

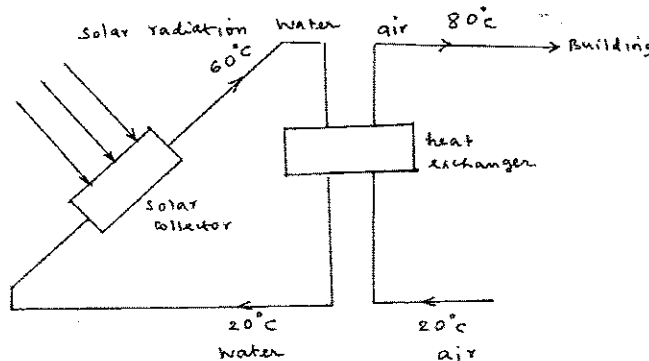
1.a. Compare *Renewable* and *Non-renewable* energy sources:- (6marks)

b. Describe the role of Per Capita Energy consumption in the standard of living of a country : - (6 marks)

2.a. What is the difference between diffuse, direct and global Solar Radiation: - Define Air Mass, When air mass become zero and 1 ? (8 marks)

b. Calculate the *Local solar time*, *Declination angle*, *Hour angle* and *Zenith angle* in New Delhi ($28^{\circ}38'N$, $77^{\circ}17'E$) on December 9, having altitude of 26° . Equation of correction factor is $-2^{\circ}12''$ (10 marks)

3 a) A solar hot air system for a residential building is shown in Fig. Calculate hot water produced in kg per day and hot air delivered to building in kg per hour. The solar radiation is $5\text{KWh/m}^2\text{-day}$ and collector efficiency and area are 50 % and 100 m^2 respectively. Assume the $C_{p,w} = 1.163\text{ Wh/kg-K}$ and $C_{p,a} = 1.0082\text{ kJ/ kg-K}$ (8 marks)



b) Write short note on Central Receiver System (6 marks)

c) Explain briefly the working principle of solar pumping and name the different pumps used (6 marks)

4. What are the different components in PV systems?

5. What is meant by *Dark Phase*?

6. What are the factors affecting Solar cell performance?

7. How many PV Cell connected in series/ parallel needed for getting 110Volts ?

BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2010 – 2011

A

Course Code: BITS C462

FINAL YEAR

Date: 14.03.11

Course Title: RENEWABLE ENERGY

Max Marks: 16

Duration: 20 minutes

Weightage: 8%

Name: ID No: Sec / Prog:

Instructions: 1. Attempt all questions
2. All question carries equal marks

1. A wind turbine is having the following Data: Wind velocity V_i , Density ρ , Diameter of the wheel D , Wheel speed N . If the torque produced is $T = \eta \frac{1}{2} \rho D V_i^3 / N$, write the expression for maximum torque.

2. A wind turbine is having the following Data: Wind velocity = 100 m/s, Density = 1.222kg/m³, Diameter of the wheel = 20 m and exit velocity of the wind = 60 m/s. Estimate the maximum axial force.

3. A three blade propeller horizontal axis wind turbine is installed at a height of 10 m, where the wind velocity is 10 m/s. When the same wind turbine is installed at a height of 20 m, what is the velocity of the wind if $\alpha = 0.16$.

4. Name the 4 types of towers used in the construction of wind turbine.

5. Define Collector efficiency .Write the formula for efficiency of solar **Concentrated type** Collector

6. Explain Tilt factor:-

7. For a Capacitor type solar storage, The total energy can be found out by the equation (Explain each term in equation)-----

8 .What are the materials used in electromagnetic type solar storage devices:-