BITS, PILANI – DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

IV Year II Semester -2009-2010

Course: BITS C462 RENEWABLE ENERGY

COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80 **Date: 24-05-2010**

Weightage: 40 % **Time: 3 hours**

Note: *(i) Answer **Part A & B** in **separate** booklets.*

(ii) Thermodynamics tables are permitted

(iii) Draw neat sketches wherever necessary

PART A

1a) Compare the performance of various types of solar collectors. How is focusing accomplished in paraboloid dish collector? **[4Marks]**

b) Enumerate the different main applications of ***solar energy***. Describe a hot water supply system: - **[5Marks]**

c) Calculate the Sun's altitude angle and azimuth angle at 7.30 am solar time on August 1 for a location at 40^0 north latitude. **[5Marks]**

d) Determine the Local Solar time and Declination at location latitude $23^0 15^1$N, Longitude $77^0 30^1$ E at 12.30 IST on June 19. Equation of time correction is given from standard table = $1^1\ 01^{11}$ **[5Marks]**

2a) How ***bio mass*** conversion takes place? Write the main application of bio-gas **[5Marks]**

b) The following data are given for a family bio gas digester suitable for output of five cows: the retention time is 20 days, temperature 30^0C, dry matter consumed = 2 kg/day, biogas yield 0.24m^3 per kg. Burner efficiency is 60 %, methane proportion is 0.8.The heat of combustion of methane = 28 Mj/m^3. Calculate: (1) the volume of biogas digester and (ii) the power available from the Digester **[6Marks]**

3a). Explain the type of Fuel cell used mainly for large, high powered applications such as industrial generating stations **[5Marks]**

b). Explain the different process involved in the production of Hydrogen **[5Marks]**

PART B

1(a) Derive the Betz coefficient in wind energy from the energy equation **[5Marks]**

(b) A wind turbine power plant of 1MW rated output has the following data:

Power coefficient = 0.43

Wind turbine utilization per year = 2400h

Maximum axial thrust $F_{x,max}$= 172243N

Rotor speed = 300rpm

The air is at 1 standard atmospheric pressure and temperature 20°C. Calculate wind velocity, wind turbine power density, rotor diameter, annual power generation and torque on the rotor. **[6Marks]**

2(a) Discuss the various types of liquid dominated geothermal power plants. Compare their performance. **[5Marks]**

(b) In a vapor dominated hydrothermal power plant, the turbine operates with steam supply at 2 MPa, 700 ^{0}C and the exhaust passes through a condenser where the pressure is 10 kPa. The turbine is reversible and the adiabatic. If the polytrophic efficiency is 70 %, turbine – generator efficiency is 90 % and heat added to the plant is 2485 kJ/kg, calculate the mass flow rate of steam and plant efficiency. **[6Marks]**

3(a) For ocean thermal energy conversion effectiveness, discuss the factors to be considered in heat exchanger design. **[5Marks]**

(b) An open cycle of 100 kW OTEC power plant operates on the following parameters:

Temperature of warm water from surface = 27°C

Temperature at Turbine inlet = 25°C

Temperature at condenser = 15°C

Temperature of cold water at condenser inlet = 13°C.

The turbine has a polytrophic efficiency of 80 %.

Find the quality of steam at flash evaporator and turbine mass flow rate. **[7Marks]**

4. Write short notes on:

(i) Mixed phase expander (ii) Anderson cycle (iii) Tip speed ratio **[6Marks]**

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INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2009-2010

FINAL YEAR ELECTIVE (ALL BRANCHES)

RENEWABLE ENERGY BITS C462

TEST – II (OPEN BOOK)

Date: 25-04-2010; Duration: 50 min.; Maximum Marks: 40, Weightage 20%

Notes:

1. *Answer all the questions*
2. ***Hand written Note books and Text books are permitted***
3. *Assume any missing data suitably and mention the same at appropriate place in your answer*
4. *Draw neat sketches wherever necessary*

Q.1. ***Design a Bio Gas system*** for cooking only for a family 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 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 14 kg/day

  Buffalo 15 kg/day

  (*Select only one type of animals from the above*)
- 1000 litres of gas is equivalent to 1 m^3 of gas
- No. of digester = 1
- Average gas production from dung is about 40 litres / kg of fresh dung (it is same in both summer and winter)
- Retention period of dung slurry in digester is 50 days **[15Marks]**

Q.2.A. Find (i) the solidity of a wind turbine (ii) maximum obtainable power density, (iii) torque at maximum efficiency for the following given data: The turbine has much higher power coefficient and maximum efficiency of 60 %. The mean chord length of

each blade is 1 meter and diameter of the turbine is 1.27 m. The turbine operates at 40 rpm. Wind at 1 standard atmospheric pressure and 20^0C has velocity of 18 m/s.

[7 Marks]

Q.2.B. Give typical specifications for off-shore wind farms wind turbine and list out names of the plants. **[3 Marks]**

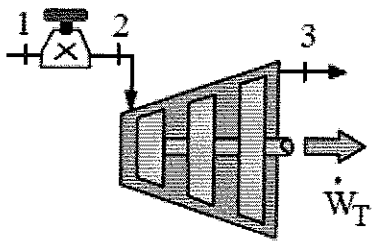
Q.3.A. Explain the environmental and operational problems related to *Geothermal power plants*. **[5 Marks]**

Q.3.B. In a vapour dominated hydrothermal power plant, one technique for operating a steam turbine in part- load power output is to throttle the steam to a lower pressure before it enters the turbine as shown in Fig. The stream conditions are 2 MPa, 400 ^{0}C and the turbine exhaust pressure is 10 kPa. Assuming the expansion inside the turbine to be isentropic process, calculate

i) The full – load actual work out put of the turbine per unit steam mass flow rate

ii) The pressure and temperature of the steam must be throttled to for 80 % of full-load output

iii) Plant efficiency at full load conditions if turbine polytrophic efficiency is 70 % and turbine – generator efficiency is 90 %, and condenser operates at 5 kPa. **[10 Marks]**



BITS, Pilani –Dubai

Dubai International Academic City, Dubai, U.A.E

IV Year II Semester 2009-2010

Test No.1 (Closed Book)

Course No. BITS C462 **Course Title:** RENEWABLE ENERGY

Date: 14-03-2010 **Max.Marks:** 50 **Weightage:** 25%

Duration: 50 min.

Notes:

- Answer all the questions
- Draw neat sketches wherever necessary
- Make suitable assumptions if required and clearly state them

1A. What is the role of Renewable Energy sources in present time for our country? **[5M]**

B. What are secondary energy sources? Give two examples **[4M]**

2A. What are causes of diffused radiation in solar system? **[4M]**

B. Determine the Local Solar Time and Declination angle at a Mumbai ($23^0\ 30^1$ N, $77^0 30^1$ E) at 12.30 IST ON June 1, 2002 AD. Equation of time correction is ($-1^1\ 01^{11}$) and longitude of standard time is $82^0 30^1$. **[6M]**

3A. Draw a neat diagram and describe the constructional aspects as well as working principle of a Solar Collector:- **[5M]**

B .Data for a Flat plate collector used for heating are given below: **[8M]**

FACTOR	**SPECIFICATION**
Location & Latitude	Mumbai $23^0\ 30^1$ N
Day & time	March 20, 13.30- 14.30(IST)
Average Intensity of solar radiation	0.58 langley/min
Collector tilt	Latitude $+12^0$
No.of glass cover	2
Heat removal factor for collector	0.825
Transmittance of glass	0.86
Absorptance of the glass	0.93
Top loss coefficient(U_L) for collector	7.8 W/m^2 ^{0}C
Collector fluid temperature	70^0C
Ambient temperature	20^0C

Calculate

(i) Solar Altitude angle

(ii) Incident angle and

(iii) Collector efficiency

4A. A solar distilled equipment manufacturer designed two types (a) and (b) with cost of each Rs 400000 . In (a) where the 50 m^2 glass plate is inclined at θ = 30 degree and solar beam is vertical to the plate and (b) where the same area of glass plate is horizontal and solar beam is inclined at θ = 30 degree to the plate as shown in Fig 1 with following design data:

Average daily solar radiation: 600 Wh/m^2-day

Latent heat of evaporation of water : 2260 kJ/kg

Cost of distilled water in the market : Rs 10 per liter

Efficiency of solar still : 30 %

Find payback period on each case.

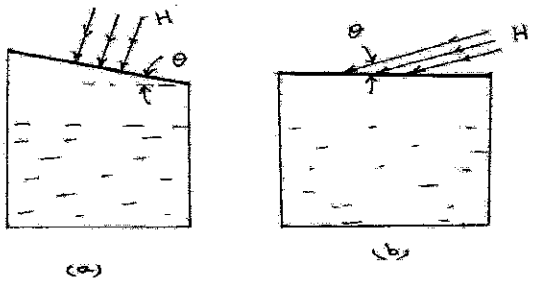


Fig 1

[8M]

B. What are heliostats? Explain the main heliostats losses. **[5M]**

C. Briefly explain with sketch the working of solar pond electric power plant. **[5M]**

BEST OF LUCK

BITS, PILANI – DUBAI

A

SECOND SEMESTER 2009 – 2010

QUIZ- 2

Course Code: BITS C462 **FINAL YEAR** Date: 11.05.2010

Course Title: RENEWABLE ENERGY Max Marks: 14

Duration: 20 minutes Weightage: 7%

Name: ..... **ID No:** ..... **Prog:** .....

1. Explain **Firing process** in the Solar Cell manufacturing :- (2 Marks)

2. Explain five factors affecting Solar cell performance: - (2 Marks)

3. Explain the **Printing process** in the Solar Cell manufacturing : (2 Marks)

4. Explain PEM fuel Cell:- (2 Marks)

5. Explain how Hydrogen can be stored? (2 Marks)

6. How can ocean temperature difference be estimated? (2 Marks)

7. What are the different construction materials used to improve the design of heat exchangers in OTEC plant? (2 Marks)

BITS, PILANI – DUBAI

SECOND SEMESTER 2009 – 2010

A

QUIZ-1

Course Code: BITS C462 **FINAL YEAR** Date: 31.03.10

Course Title: RENEWABLE ENERGY Max Marks: 16

Duration: 25 minutes Weightage: 8%

Name: ..... **ID No:** ..... **Sec / Prog:** .....

Instructions: 1. Attempt all questions

1. Explain the working principle of a **PV panel**. (2 Marks)

2. Explain how the variation of Insulation and temperature affects the **solar PV cell** (2 Marks)

3. What are the factors affecting the **Solar Cell** performances? (2 Marks)

4. How many PV cell connected in series / parallel needed for getting **220 Volts**? (2 Marks)

5. Give the important characteristics of **Savonius** and **Darrieus** type wind turbines (2Marks)

6. Derive that **maximum axial force** developed in wind turbine blade (2Marks)

7. What are the main components and their functions of a **wind energy conversion** system? (2Marks)

8. Calculate **power coefficient** for wind turbine of rotor diameter of 0.9 m. It has pump efficiency 0.95 and transmission efficiency 0.95. The wind mill pumps water 3.03 m^3/hour through a head of 28 m when the wind speed is 3.3 m/s. (2Marks)