BITS, PILANI DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

IV Year I Semester - 2010-2011

Course: BITS C462 RENEWABLE ENERGY

COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80 **Date: 23-12-2010**

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 ? **[3 Marks]**

b) Data for a Flat plate collector used for heating are given below: **[7 Marks]**

FACTOR	**SPECIFICATION**
Location & Position	Dubai (25°18'N, 55°20'E)
Day & time	August 19, 13.30- 15.30(IST)
Average Intensity of solar radiation	460 W/m^2
Collector tilt	24^0
No.of glass cover	2
Heat removal factor for collector	0.815
Transmittance of glass	0.876
Absorptance of the glass	0.898
Top loss coefficient(U_L) for collector	8.95 $W/m^2\,^0C$
Collector fluid temperature	72^0C
Ambient temperature	28^0C

Calculate

(i) Solar altitude angle

(ii) Incident angle and

(iii) Collector efficiency

2a) What are the disadvantages of using biomass energy? **[3 Marks]**

b) What are the environmental benefits of biomass? **[3 Marks]**

c) How is electricity created with biomass? **[3 Marks]**

d) The following data are given for a family bio gas digester suitable for output of five cows: the retention time is 22 days, temperature 28^0C, dry matter consumed = 3 kg/day, biogas yield 0.26m^3 per kg. Burner efficiency is 62 %, methane proportion is 0.85.The heat of combustion of methane = 26 Mj/m^3. Calculate: (1)the volume of biogas digester and (ii) the power available from the digester **[4 Marks]**

3a) What are the types of fuel cells? What is a Direct Methanol Fuel Cell? **[4 Marks]**

b). Find the ***reversible voltage*** for the methanol Fuel Cell having the reaction:

$CH_3OH + 1.5O_2 = CO_2 + 2H_2O$

$CH_3OH + H_2O \Leftrightarrow CO_2 + 6H^+ + 6E^-$

Given $G_{25}{}^0{}_C$ = - 167,340 Cal/ gm-mole **[5 Marks]**

4) Write short Notes on: **i)** MSW

ii) Doping in PV Cell

iii) Difference between a ***fuel cell*** and a ***battery***

iv) Anaerobic digestion **[8 Marks]**

PART B

5.(a) A low temperature solar power generation plant is shown in Fig 5. The mass flow rate of water through the solar collector is 1000 kg/hr. The temperature of water inlet and outlet of storage tank are 80 ^{0}C and 25 ^{0}C respectively. The organic fluid ammonia is a working fluid for turbine which has turbine inlet temperature of 50 ^{0} and saturated vapor. If the power developed by the turbine is 0.5 MW and mass flow rate of ammonia is 1585 kg/hr, find temperature and quality of ammonia leaving the turbine. Assume average C_p for water as 4.181 kJ/kgK and that for ammonia as 4.84 kJ/kgK and efficiency of turbine as 100%. **[7 Marks]**

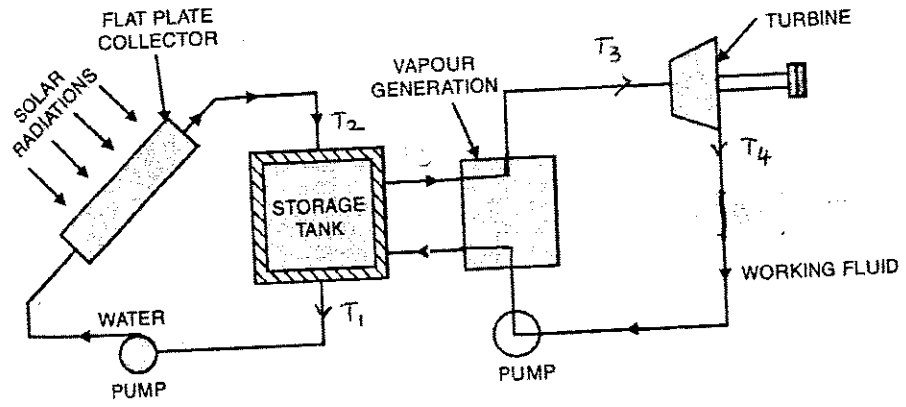


Fig 5

(b) What are the limitations of solar thermal power plant? **[3 Marks]**

6(a).A propeller type, horizontal shaft wind turbine is working at 1 atmospheric pressure and 15 ^{0} C and runs at 40 rpm. The performance of total wind power produced by it follows as:

$P = AV - B$ where V is wind velocity and A & B are constants.

At two different wind speeds 10 m/s and 15 m/s , the maximum wind power measured are 1 MW and 2.5 MW respectively . Calculate the maximum power developed by the wind turbine for the wind speed of 18.8 m/s and also calculate (i) maximum Torque and (ii) maximum axial Thrust for the same wind speed. **[7 Marks]**

(b) Define the following terms (i) Tip speed ratio and (ii) Solidity **[3 Marks]**

7(a) In a vapor 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.7. The steam conditions are 2 MPa, 400 ^{0}C and the turbine exhaust pressure is 10 kPa. Assuming the expansion inside the turbine is to be isentropic process, calculate (i) the full – load actual work out put of the turbine per unit steam mass flow rate and (ii) the pressure and temperature of the steam must be throttled to for 80 % of full- load output **[7 Marks]**

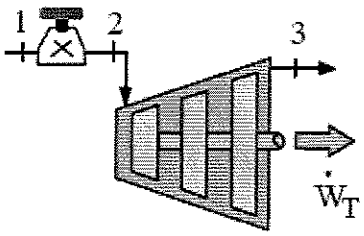


Fig 7

(b) What are the resources of geothermal energy? **[3 Marks]**

8. Write short note on

(i) Lambert's Law of absorption **[2 Marks]**

(ii) Claude Cycle for OTEC **[5 Marks]**

(iii) Bio-fouling **[3 Marks]**

BITS, PILANI – DUBAI

INTERNATIONAL ACADEMIC CITY, DUBAI

FIRST SEMESTER 2010-2011

IV YEAR RENEWABLE ENERGY BITS C462

TEST – II (OPEN BOOK)

Date: 11-11-2010; 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*

Q.1. ***Design a Bio Gas system*** for cooking only for a family of 4Adults 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 12 kg/day

  Bullock 15 kg/day

  Buffalo 16 kg/day

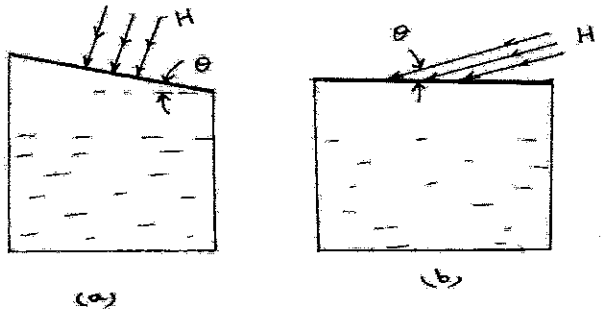
  (*Select only one type of animals from the above*)
- 1000 litres of gas is equivalent to 1 m^3 of gas
- No. of digester = 3
- Average gas production from dung is about 42 litres / kg of fresh dung (it is same in both summer and winter)
- Retention period of dung slurry in digester is 25 days **[12Marks]**

Q.1B. "The use of bio mass for energy application may not be appropriate at some locations" Comment:- **[4 Marks]**

Q.2A A solar distil equipment manufacturer designed two types; (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 the glass plate is horizontal and solar beam is inclined at θ = 30 degree to the plate as shown in Fig with the following design data parameters:

Average daily solar radiation	: 600 Wh/ m^2 – day
Latent heat of evaporation of water	: 2260 kJ/kg
Efficiency of solar distil	: 30 %

Find the suitable type of solar distil equipment. **[8 Marks]**



B. Write short note on solar pond electric system **[4 Marks]**

Q.3A A 250 MW vapor dominated hydrothermal power plant uses saturated steam at 31 bar at shut off. The steam is throttled to a turbine at inlet pressure of 10 bar. A direct contact condenser operates at pressure of 0.40 bar with cooling tower exit temperature 25 ^{0}C. The turbine efficiency is 72%.Calculate steam mass flow rate and plant efficiency. **[8 Marks]**

B. What are the operating and environmental constrains in the design of geothermal power plants:- **[4 Marks]**

BITS, Pilani –Dubai

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

IV Year I Semester 2010-2011

Test No.1 (Closed Book)

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

Date: 03-10-2010 **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 are the advantages and limitations of renewable energy sources? **[5M]**

B. What is meant by ***Non–conventional energy*** sources? Explain in brief these energy sources with special reference to U A E ? **[5M]**

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

B. Define the following terms:

i) Insolation **ii)** Altitude angle **iii)** Air Mass **iv)** Azimuth angle **[8M]**

C. Determine the Local Solar Time and Declination angle at New Delhi ($28^0 38^1$N, $77^0 17^1$E) at 10.30 IST ON August 1, 2002 AD. Equation of time correction is ($-1^1\ 01^{11}$). **[8M]**

3A. A wind mill with 9 blades in a rotor lifts 3.025 m^3/hour of water through a head of 30 meter when the speed of wind is 3.5 m/sec. If the width of the blade is 25 cm and solidity for the machine is 0.075, calculate the power coefficient. Assume the transmission efficiency as 90%, pump efficiency as 65 %, specific gravity of water as 0.976 and specific gravity of air as 1.2×10^{-3}. **[10M]**

B. Explain about Betz coefficient in wind energy **[5M]**

c. Give comparison study of Darrieus and Savonius type rotor wind energy conversion systems. **[5M]**

BEST OF LUCK

BITS, PILANI – DUBAI

A

FIRST SEMESTER 2010 – 2011

QUIZ- 2

Course Code: BITS C462 **FINAL YEAR** Date: 06.12.2010

Course Title: RENEWABLE ENERGY Max Marks: 14

Duration: 20 minutes Weightage: 7%

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

1. How can ocean temperature difference be calculated? (3 Marks)

2. The property values for Open Cycle Ocean Thermal Energy Conversion are given below:

Point in the cycle	Temp ^{0} C	Pressure bar	v_f m^3/kg	v_g m^3/kg	h_f kJ/kg	h_g kJ/kg	h_{fg} kJ/kg
Surface Water 10^5 kg/s	27	0.03564	.0010036	38.82	113.20	2550	2437
Turbine inlet	25	0.03166	.0010030	43.4	104.8	2547	2442

Find the quality of steam at flash separator, x_2 , mass flow rate of steam (kg/s) entering the turbine. (4 Marks)

3. What are the different methods for Hydrogen production? (2 Marks)

4. Explain PEM fuel Cell:- (3 Marks)

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

BITS, PILANI – DUBAI

FIRST SEMESTER 2010 – 2011

A

QUIZ-1

Course Code: BITS C462 **FINAL YEAR** Date: 25.10.10

Course Title: RENEWABLE ENERGY Max Marks: 16

Duration: 25 minutes Weightage: 8%

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

Instructions: 1. Attempt all questions

1. What are the ***four*** types of ***concentrated type*** of solar Collector? (2 Marks)

2. Explain Solar ***Collector Efficiency*** (2 Marks)

3. What are the applications of ***Air heaters***? (2 Marks)

4. Explain ***Solar Electrical Storage*** (2 Marks)

5. What are the ***materials*** used in ***Thermal Storages*** (2Marks)

6. What are the basic design principles involving in passive space heating system? (2Marks)

7. Briefly explain the difference between the Brayton and Rankin cycle in working principle. (2Marks)

8. How is in low temperature system (60^0C – 90^0C), solar energy converted into electrical energy? (2Marks)