

BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
IV Year II Semester - 2011- 2012
Course: BITS C462 RENEWABLE ENERGY
COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80

Date: 05-06-2012

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

(iv) Answer Every Question on a fresh page

PART A

1a) Explain *air mass*

[3 Marks]

b) Data for a Flat plate collector used for heating are given below:

[7 Marks]

FACTOR	SPECIFICATION
Location & Latitude	COIMBATORE 22° 00' N
Day & time	Jan 1 , 11.30- 12.30(IST)
Average Intensity of solar radiation	0.5 langle/min
Collector tilt	Latitude + 15°
No.of glass cover	2
Heat removal factor for collector	0.810
Transmittance of glass	0.88
Absorptance of the glass	0.90
Top loss coefficient(U_L) for collector	7.88 W/m ² °C
Collector fluid temperature	60°C
Ambient temperature	15°C

Calculate

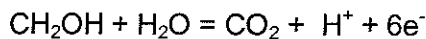
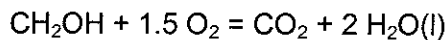
- (i) Solar altitude angle
- (ii) Incident angle and
- (iii) Collector efficiency

2a) Explain the application of **bio-mass** : - [4 Marks]

b) Calculate; (i) the **volume** of biogas digester suitable for the output of six cows, and (ii) the **power** available from the digester. Retention period is 25 days, temperature 32°C, dry matter consumed 2.5kg/day, biogas yield 0.26 m³ per kg. Burner efficiency is 62%, Methane proportion is 0.82. The heat of combustion of methane may be assumed to be 28MJ/m³ at STP. [6 Marks]

3a). What is the principle of solar photovoltaic cell power generation? [5 Marks]

b). Find the **reversible voltage** for methanol fuel cell having the reaction



Given $\Delta G_{25^\circ\text{C}}^\circ = -167340 \text{ Cal/gm.mole}$ [4 Marks]

4a). A 110 kW, 110 volt, thermoelectric generator operates between 250°C and 550°C. The average value of the seebeck coefficient is $400 \times 10^{-6} \text{ V/K}$. The generator average resistance is 0.004 ohm. Find the **open circuit voltage**, **number of thermocouples** in series, **heat input** and **rejected** at full load. The current density in the elements is limited to 18 amp/cm² and the max. area is 45cm² [8 Marks]

b. Write a short note on thermo electric materials [3 Marks]

PART B

1.(a) Explain briefly the working principle of solar furnace . [3 Marks]

(b) The following data are used for design of a solar water heater:

Solar radiation	: 6 KWh /m ² -day
Hot water required	:1000 Liters/day
Hot Water temperature	:55 °C
Cold water temperature	:15 °C
Specific heat for water	:4.18 kJ/kgK

- (i) If a single collector has an area of 2.5 m² and its efficiency is 0.55, find the total area required and number of solar collector modules.
- (ii) The cost of solar collector is Rs. 2,00,000 . An electrical heater is used with efficiency of 0.95 and cost of 1 unit = 1 kWh = Rs.6 , calculate the payback period, if the solar water heater is used for 300 days per year. [7 Marks]

2(a) What are the important characteristics of Savonius and Darrieus type wind turbines. [3 Marks]

(b) A wind mill with 3 blade rotor lifts $4.06 \text{ m}^3/\text{hour}$ of water through a head of 35 m when the tip speed ratio is 0.6 and it rotates at 20 rpm. If the width of the blade is 25 cm and solidity is 0.05, calculate the power coefficient, torque and maximum torque produced. Assume the following: transmission efficiency 85% ,pump efficiency 70%, density of water 988 kg/m^3 , density of air 1.222 kg/m^3 . [7 Marks]

3(a) Define the terms: (i) magmetic steam and (ii) meteoritic steam. [2 Marks]

(b) Vapor – dominated geothermal power plant of 200 MW uses saturated steam of 3 MPa pressure. The steam is throttled to a turbine at inlet pressure of 1.00 MPa. A direct contact condenser operates at a pressure of 0.225 MPa, where the cooling water is at temperature of 25°C . The polytrophic efficiency of turbine is 0.85.

(i) Calculate steam flow rate

(ii) If the power plant is working half -load (100 MW), calculate the condition of steam entering the turbine.

(iii) Find the heat added to the power plant. [8 Marks]

4(a) Anderson , OTEC cycle [4 Marks]

(b) Bio-fouling [3 Marks]

(c) Lamber' law [3 Marks]

BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2011-2012
RENEWABLE ENERGY BITS C462

TEST-II (OPEN BOOK)

Date: 16- 05- 2012 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(a). Explain the comparison of performance of different types of liquid-dominated systems **[5 Marks]**

(b) A 20 MW power output of liquid – dominated geothermal power plant uses hot water at a temperature of 250⁰C under high pressure from 1 km depth from earth surface. The hot water passes to a single flash separator which is operating at a pressure of 0.050 MPa. The condenser pressure is 0.020 MPa and the temperature of water exit from the condenser is 25⁰ C. If polytropic efficiency of turbine is 0.85 and heat loss from the turbine is 20 kJ/s, calculate hot water flow rate from earth surface in kg/hour and heat supplied to the power plant in kJ/kg. **[10Marks]**

Q.2. Prepare a **case study** (Project report) based on a survey report on installing Co-operative Power Plant in Noida near Delhi incorporating different power requirements and different renewable energy availability. All the energy needs of the place can be met locally from the available bio mass. **Explain with the salient features of the projects**
Also Suggest suitable design parameters for the required community bio gas plant with calculation of volume of the daily discharge, diameter, height etc.

Note:- Marks will not be awarded if the same items are repeated from the text book.

[15 Marks]

Q3.a). 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]**

4. Explain solar azimuth angle

It is the horizontal angle measured from north to the horizontal projection of the sun's rays

5. Write the expression for (i) P_{tot} and (ii) P_{max}

6. Derive for axial force on turbine wheel while operating at maximum efficiency

7. What are the different types of supporting towers for wind mill

8. A wind turbine with tip speed ratio of 3 is having rotor diameter of 2 meter and speed is 2 revolutions per sec. Find the power available in the wind if the density of the wind is 1.222 kg/m^3

BITS Pilani, Dubai Campus

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

IV Year II Semester 2011-2012

Test No.1 (Closed Book)

Course No. BITS C462

Course Title: RENEWABLE ENERGY

Date: 28-03-2012

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

1. a Explain the major functions of controls in the wind turbine. [5M]

b. A propeller type horizontal shaft wind turbine with diameter of 60 m is rotating at 120 rpm. The wind turbine is working at maximum efficiency and power measured is 100 kW. Find wind velocity, maximum torque produced and tip speed ratio. Assume density of air is 1.222 kg/m^3 [10M]

2.a Explain the various material and their purposes in the operation of solar distillation [5M]

b. The solar air heating system has two numbers of flat plate collectors of each area is 2m^2 . Temperature of water entering and leaving are air heating system are 70°C and 40°C , temperature of air entering and leaving are air heating system are 25°C and 50°C , specific heat for water and air are 1.163 Wh/kg-K and 1.004 kJ/kg-K . Find the mass flow rate of water and air in kg/day if efficiency of collector is 40% and solar intensity is $5.5 \text{ kWh/m}^2\text{-day}$ [10M]

3.a What is the principle of solar Photovoltaic power generation? What are the main elements of a PV system: - [5M]

b. Classify the methods of solar energy storage: - [5M]

c. Calculate the **Useful gain** 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 $\rho = 0.85$, $(\zeta. \alpha) = 0.77$,

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

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

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 400kg/hr .

The fluid has $C_p = 1.256 \text{ kJ/kg }^\circ\text{C}$. The heat removal factor is 0.8329 [10M]

BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2011 – 2012
QUIZ - II

A

Course Code: BITS C462

FINAL YEAR

Date: 02.05.12

Course Title: RENEWABLE ENERGY

Max Marks: 14

Duration: 20 minutes

Weightage: 7%

Name: ID No: Sec / Prog:

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

1. What are the three broad geothermal fields? And give the range temperature gradient values?
2. What are the two main classification of hydrothermal system and what is the state of the steam enters the turbine in each category?
3. If the steam contains mixture of liquid and vapor at a pressure of 1400 kPa and its enthalpy value is 1320 kJ/kg. The value of enthalpy of saturated water = 830 kJ/kg and enthalpy of saturated steam = 2790 kJ/kg. Find the quality of steam: - .

4. Explain the plants used as bio mass in the biogas plant:-

5. Explain the methods of manufacture of Methanol:-

6. Explain MSW:-

7. Write short notes on Bio-Diesel:-

5. Write the expression for (i) P_{tot} and (ii) P_{max}

6. Derive for axial force on turbine wheel while operating at maximum efficiency

7. What are the different types of supporting towers for wind mill

8. A wind turbine with tip speed ratio of 3 is having rotor diameter of 2 meter and speed is 2 revolutions per sec. Find the power available in the wind if the density of the wind is 1.222 kg/m^3