

BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
IV Year I Semester - 2012- 2013
Course: BITS C462 RENEWABLE ENERGY
COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80

Date: 31-12-2012

Weightage: 40 %

Time: 3 hours

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- Note:** (i) *Thermodynamics tables are permitted*
(ii) *Draw neat sketches wherever necessary*
(iii) *Answer Every Question on a fresh page*
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1) Calculate the **useful gain**, the **exit fluid temperature** and the **collector efficiency** for a cylindrical parabolic concentrator having 2.5 m width and 9 m length, the outside diameter of the absorber tube being 6.5 cm. The temperature of the fluid to be heated at the inlet is 18°C with a flow rate of 475 kg/h. the incident beam radiation is 650 W/m². The ambient temperature is 30°C.

The optical property is 0.76 and heat removal factor is 0.82, C_p is 1.25 kJ/kg°C

[8M]

2) Design a **Solar still** with average daily solar radiation on given location is 6 kWh/m² day with efficiency of 35%. The distilled water required/day is 15 litres. Also calculate the **payback period** with manufacturing cost/m² is Rs.20,000 and distilled water cost Rs.15/litre.

[7M]

3) Find out the time required for cooking 2 kg of potatoes using a dish type concentrating solar cooker. Use the following assumptions:-

- Direct solar radiation at given instant - 600 W/m²
- Diameter of the pot area - 0.30 meters = 0.28 m² area
- Diameter of collector aperture = 1.5 m = 7.05 m² area
- Concentration ratio = 25
- Optical efficiency of the collector – 80 %
- Efficiency of solar cooker – 35 %

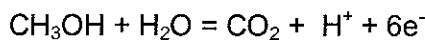
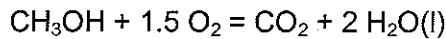
[8M]

4) Calculate; (i) the **volume** of biogas digester suitable for the output of 4 cows, and (ii) the **power** available from the digester. Retention period is 20 days, temperature 30°C, dry matter consumed 2.4kg/day, biogas yield 0.26 m³ per kg. Burner efficiency is 60%, Methane proportion is 0.82. The heat of combustion of methane may be assumed to be 28MJ/m³ at STP.

[7M]

5) A 100 MW Vapor dominated geothermal system uses saturated steam from a well with a shut off pressure of 28 bar. Steam enters the turbine at 5.5 bar and condenses at 0.15 bar. The cooling tower exit is at 20°C. Calculate the necessary steam flow, the cooling water flow and the plant efficiency and the heat rate. The polytrophic efficiency of turbine is 0.85 and the turbine generator combined mechanical efficiency is 0.9 [7M]

6). Find the **reversible voltage**, and the **efficiency** for methanol fuel cell having the reaction



Given $\Delta G_{25^\circ\text{C}}^0 = -167340 \text{ Cal/gm.mole}$ $\Delta H_{25^\circ\text{C}}^0 = -197694 \text{ Cal/gm.mole}$

Also compute the heat transferred to the surroundings. [6M]

7) A single basin type tidal power plant has basin area of 20km². The tide has a range of 8 m. the turbine stops operation when the head on it falls below 4 m. Calculate the average power generated during the process in MW, if the turbine-generator efficiency is 75%. [8M]

8 (a) Derive expression for (i) Betz coefficient and

$$(ii) F_{x, \text{max}} = \frac{\pi}{8} \rho D^2 V^2_1 \quad \text{from energy equation} \quad [6M]$$

(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%, density of water 988 kg/m³, density of air 1.222 kg/m³. [8M]

9) Write short notes on

[3x5 =15 M]

- i) Plants & Trees used as Bio mass
- ii) Different layers of Geothermal fields
- iii) OTEC cycle
- iv) Alkaline fuel cell
- v) Beam & diffused Radiation

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IV Year I Semester 2012-2013

Test No.2 (Open Book)

Course No. BITS C462

Course Title: RENEWABLE ENERGY

Date: 22-11-2012

Max.Marks: 40

Weightage: 20%

Duration: 50 min.

Notes:

- Answer all the questions
 - Draw neat sketches wherever necessary
 - Make suitable assumptions if required and clearly state them
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1. **Design a solar PV system** to pump 10000 litres of water from a depth of 4 meters. The water needs to be discharged at about 5 meters from the well. What would be the cost of the system? Design includes calculation of TDH, Hydraulic energy required to raise water level, No. of PV panel and pump size :- **[15Marks]**
2. For a community based solar cooker system installed at a hostel in a school, total investment required was Rs.50000. The solar cooker usage reduced the LPG cylinder consumptions by 38 cylinders per year. **Calculate payback period:- [10Marks]**
3. **Design a Bio Gas system** for cooking only for a family of 6Adults 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:- **[15Marks]**

Following assumptions are made for the design:

- About 300-400 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)

- No. of digester = 4
- Average gas production from dung is about 42 litres / kg of fresh dung in winter and 60 litres / kg in summer
- Retention period of dung slurry in digester is 25 days

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IV Year I Semester 2012-2013

Test No.1 (Closed Book)

Course No. BITS C462

Course Title: RENEWABLE ENERGY

Date: 04-10-2012

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.) What are primary and secondary energy sources? [5 M]

(B). What are the advantages and limitations of Renewable energy sources? [5 M]

2(A). Define the following terms: [6 M]

- Insolation
- Altitude angle
- Zenith angle
- Slope

(B). At Nagpur ($19^{\circ} 07' N$, $72^{\circ} 51' E$), the following observations were made:

Theoretical maximum possible sunshine hours: 12.50 h

Average measured length of a day during April: 8.00 h

Constant $a = 0.27$, $b = 0.50$

Determine the average value of solar radiation on a horizontal surface for April 22 [14 M]

3A. A wind mill with 5 blade rotor lifts $4.05 \text{ m}^3/\text{hour}$ of water, when the wind speed is 4.4 m/s . If the chord length of the blade is 30 cm , solidity is 0.025 and the power coefficient is 0.4 , calculate the head of water. Assume the following: Transmission efficiency 85% , Pump efficiency 70% , density of water 988 kg/m^3 , density of air 1.222 kg/m^3 . [10 M]

B. Derive $V_{e, \text{ optimum}} = \frac{1}{3} V_i$ for the wind turbine blade [6 M]

C. What are the main characteristics of (i) Savonius rotor and (ii) Darries rotor of vertical axis wind turbine [4 M]

QUIZ-2

Course Code: BITS C462

FINAL YEAR

Date: 13.12.2012

Course Title: RENEWABLE ENERGY

Max Marks: 14

Duration: 20 minutes

Weightage: 7%

Name:	ID No:	Prog:
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1. Explain MSW (3 Marks)

2. Explain one method of production of ethanol:- (3 Marks)

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

4. Explain PEM fuel Cell:-

(3 Marks)

5. Explain how Hydrogen can be stored?

(2 Marks)

BITS PILANI, DUBAI CAMPUS
FIRST SEMESTER 2012 – 2013

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QUIZ - 1

Course Code: BITS C462

FINAL YEAR

Date: 23.10.12

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. What are the different types of Flat plate of solar Collector? [3 M]

2. Explain Concentration ratio of a Solar Collector [3M]

3. For a parabolic collector of length 2 metre, the angle of acceptance is 15° . Find the concentration Ratio:- [4M]

4. Discuss the parameters governing the performance of a Flat plate Collector:- [3M]

5. What are the Advantages and disadvantages of concentrating Collectors over a Flat plate Collector:- [3M]