

BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
IV Year I Semester -2009-2010
Course: BITS C462 RENEWABLE ENERGY
COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80

Date: 23-12-2009

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) Answer Every Question on a fresh page
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PART A

- 1a) Explain the working principle and performance features of a *PV panel*: - [4 Marks]**
b) Data for a Flat plate collector used for heating are given below: [8 Marks]

FACTOR	SPECIFICATION
Location & Latitude	Cochin $11^{\circ} 00' N$
Day & time	March 22, 14.30- 15.30(IST)
Average Intensity of solar radiation	560 W/m^2
Collector tilt	26°
No.of glass cover	2
Heat removal factor for collector	0.82
Transmittance of glass	0.88
Absorptance of the glass	0.93
Top loss coefficient(U_L) for collector	$7.95 \text{ W/m}^2 \text{ }^{\circ}\text{C}$
Collector fluid temperature	75°C
Ambient temperature	25°C

Calculate

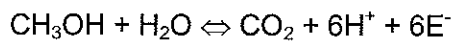
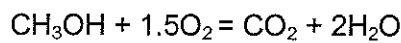
- (i) Solar altitude angle
- (ii) Incident angle and
- (iii) Collector efficiency

2a) Explain different **bio-mass conversion** technologies: - [5 Marks]

b) Calculate; (i) the **volume** of biogas digester suitable for the output of four cows, and (ii) the **power** available from the digester. Retention period is 20 days, temperature 30°C, dry matter consumed 2kg/day, biogas yield 0.24 m³ per kg. Burner efficiency is 60%, Methane proportion is 0.8. Hm the heat of combustion of methane may be assumed to be 28MJ/m³ at STP. [6 Marks]

3a). What is **Fuel cell**? Describe the principle of working of a fuel cell with reference to H₂-O₂ Cell [5 Marks]

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



Given $G_{25}^0_{\text{C}} = -167,340 \text{ Cal/ gm-mole}$

[5 Marks]

4) Write short Notes on: i) MSW

ii) Solar Flat plate Collector

iv) Difference between a **fuel cell** and a **battery** [7 Marks]

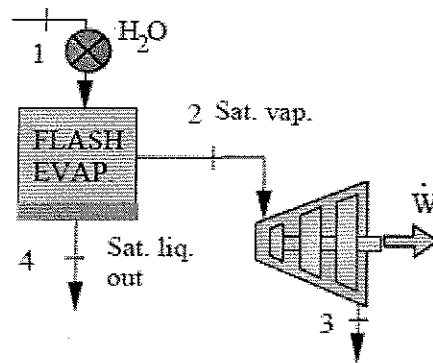
PART B

1a) Discuss in details the **operation** and **control** of a wind turbine. How the variation of wind velocity and its directions are taken care? [6 Marks]

b) A wind mill with multi blade rotors lifts 3.03 m³/hour of water through a head of 28 m when the wind speed is 3.3 m/s. Calculate the **power coefficient** for a rotor diameter of 4.5 m. Assume the transmission efficiency as 95 % and pump efficiency as 70%, specific gravity of water as 0.996 and specific gravity of air as 1.2x10⁻³. [7 Marks]

2a) Explain with neat sketch the working principle of binary cycle geothermal power plant [7 Marks]

b) A geothermal supply of hot water is used to operate a steam turbine, as shown in Fig(1). The high-pressure water at 2 MPa, 200°C, is throttled into a flash evaporator chamber, which forms liquid and vapor at a lower pressure of 450 kPa. The liquid is discarded while the saturated vapor feeds the turbine and exits at 10 kPa, dry saturated steam. If the turbine should produce 2000 kW, find the required mass flow rate of hot geothermal water. [7 Marks]



Fig(1).

3.a) Compare the following:

- (i) Claude cycle and (ii) Anderson cycle of OTEC plants

[7 Marks]

b) In Gulf of Cambay, which is being considered for possible tidal power generation, during the tide cycle, the observed difference between the high and low water of the tide was 10.8 m. It has been estimated that this estuary having an area of 10 km² can generate power for 3 hours in each cycle. Assuming the average available head to be 10 m and the total efficiency of generation system to be 75 %. Calculate :

- (i) the power in HP at any instant
 (ii) (ii) the total energy generated in the year

Take the specific gravity of sea water as 1.025

[6 Marks]

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FIRST SEMESTER 2009-2010
FINAL YEAR ELECTIVE (ALL BRANCHES)
RENEWABLE ENERGY BITS C462

TEST – II (OPEN BOOK)

Date: 22-11-2009; Duration: 50 min.; Maximum Marks: 40, Weightage 20%

Notes:

1. *Answer all the questions*
 2. *Photocopy of the text book with spiral binding, Hand written Note books and Thermodynamic table are permitted*
 3. *Assume any missing data suitably and mention the same at appropriate place in your answer*
 4. *No marks will be awarded if the same data is copied from the text book for the case study problem. (Q.No.3)*
 5. *Draw neat sketches wherever necessary*
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1.A. What are the operating and environmental constraints in the design of geothermal power plants? **(3Marks)**

B. A hot water geothermal plant with capacity 12×10^6 W, of the total flow type receives water at 250° C. The hot water flow rate is 12.62×10^5 kg/hour. The plant uses a direct contact condenser that operates at 0.3 bar. The turbine has polytropic efficiency of 70%. Calculate the pressure in bar at turbine inlet and plant efficiency. **(7 Marks)**

2.A. Explain the material and their purpose of various components in the operation of solar distillation plant? **(4 Marks)**

B. The following data used for the design of solar water heater:

Solar radiation = 5 kWh/m²/day

Hot water required = 1000 kg/day

Hot water temperature = 45° C

Cold water temperature = 14° C

$C_{pw} = 1.163$ Wh/kg-K

Mean efficiency of water heater = 48 %

If a single plant has an area of 2.2 m², Find out total area required and number of solar collector modules. **(6 Marks)**

P.T.O.

3. Make a case study [survey Report] for the Total energy required and Availability in a village in India using Bio gas considering salient features like industrial, Agricultural Domestic community load etc. **(12 Marks)**

4. Design different solar storage equipment required for cooking food, Heating water, Power generations using solar ponds and a green house for vegetations in a village in India using solar energy discussing the salient features:-

(8 Marks)

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TEST – 1(CLOSED BOOK)

Date: 04-10-2009; 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
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1.A. Compare **Renewable** and **Non-renewable** energy sources:- (6marks)

B. Describe the role of **Solar energy** in Renewable Energy source: - (6 marks)

2.A. Define the following terms:

- i) Zenith angle
- ii) Declination angle
- iii) Altitude angle
- iv) Latitude angle

(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. Explain the functions of each components of a **wind energy conversion** system with a neat sketch. (10 marks)

B. A propeller wind turbine has a diameter of 120 m and runs at 40 rpm at efficiency of 78%. The wind at 1 standard atmospheric pressure and $15^{\circ}C$ has a velocity of 15 m/s. Calculate (i) the total power density in the wind stream (ii) obtainable power density (iii) the total power (iv) torque and (v) thrust when the exit velocity is 8 m/s.

(10 marks)

5. Explain Solar distillation Efficiency :-

(2Marks)

6. What is the purpose of Solar Bond in Power generation ?

(1.5Marks)

7. What is doping ?

(2Marks)

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

(1.5Marks)

BITS, PILANI – DUBAI
FIRST SEMESTER 2009 – 2010

A

QUIZ – I

Course Code: BITS C462

FINAL YEAR

Date: 28.09.09

Course Title: RENEWABLE ENERGY

Max Marks: 16

Duration: 20 minutes

Weightage: 8%

Name: ID No: Sec / Prog:

Instructions: 1. Attempt all questions

1. Explain the difference between *Renewable & Non-Renewable Energy*: Illustrate with one example. (2 Marks)
2. Write about the *total incoming* solar radiation, amount radiation *available* on earth & Rate of consumption of *Fossil* and *Nuclear* fuels as on 2002 (2 Marks)
3. What is *Solar Constant*? According to *NASA* what is its value? (2 Marks)
4. What is *Air Mass* (AM)? When is its value become 1 & 2? (2 Marks)

PTO

5. Write about *Equinox* & *Solstice* and corresponding *Declination* angle

(2Marks)

6. Prove that the Betz coefficient value is 0.593.

(2Marks)

7. Derive that maximum axial force developed in wind turbine blade is

(2Marks)

$$\frac{\pi}{9} \rho D^2 V_i^2$$

8. Name 4 different types of towers for wind turbine .

(2Marks)