

BITS, PILANI- DUBAI  
Second Semester 2007- 08

RENEWABLE ENERGY BITS UC 462

Final Year

COMPREHENSIVE EXAMINATION (CLOSED BOOK)

Max. Marks: 40

Date: 25-05-08

Duration: 180 min

Instructions.

- Answer all the questions.
- Answer all questions sequentially.
- Steam tables are allowed  
Draw neat sketches wherever necessary
- Make suitable assumptions if required and clearly state them

1. a. Enumerate the different main applications of **solar energy**. Describe a hot water supply system:- [3M]
  - b. Calculate the Sun's altitude angle and azimuth angle at 7.30 am solar time on August 1 for a location at  $40^{\circ}$  north latitude. [3M]
2. a. What is the basic principle of **wind energy** conversion? Describe the main application of wind energy, giving neat sketches:- [3M]
  - b. A 12 m/s wind is at 1.0123 standard atmosphere and  $16^{\circ}\text{C}$ . Calculate:
    1. The total power density in the wind stream
    2. The maximum obtainable power density
    3. A reasonably obtainable power density
    4. Total power produced if the turbine diameter is 125 m.
3. a. How **bio mass** conversion takes place? Write the main application of bio-gas: [4M]
  - 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  $30^{\circ}\text{C}$ , dry matter consumed = 2 kg/day, biogas yield  $0.24\text{m}^3$  per kg. Burner efficiency is 60 %, methane proportion is 0.8. The heat of combustion of methane =  $28\text{Mj/m}^3$ .  
Calculate: (1) the volume of biogas digester and (ii) the power available from the digester:- [4M]

4. What are the main types of **OTEC** plants? Describe them briefly. (3M)  
 b. What are the advantages and limitations of **wave energy** conversion?

Define **Geothermal** process. Explain one type of Geothermal system.

- b. A 100 MW vapor-dominated system uses saturated steam from a well with a shut-off pressure of 15 bar. Steam enters the turbine at 15 bar and condenses at 1 bar. The turbine polytropic efficiency is 0.82 and the turbine-generator combined mechanical efficiency is 0.9. The cooling tower exists at 20°C. Calculate the necessary steam flow, the cooling water flow and the plant efficiency and the heat rate if injection occurs prior to cooling tower.

(4M)

6. Write short notes on **Fuel cell**.

(3M)

- b. What are the principles of solar **photovoltaic** power generation? What are the main components of a PV system?

(3M)

GOOD LUCK

**BITS, PILANI – DUBAI,  
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SECOND SEMESTER 2007-2008  
BITS UC462 RENEWABLE ENERGY**

**TEST – 2(OPEN BOOK)**

**Date: 20-04-2008; Duration: 50 min.; Maximum Marks: 20, Weightage 20%**

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*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*
  4. *Only text book and hand written notes are permitted.*
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1. Design a non convective solar pond with 1000sq.m equipped with 25 kW.  
Describe the suitable solar collector, storage system and extraction of thermal energy from them. (6 marks)
2. Wind at 1 standard atmospheric pressure and 15°C temperature has a velocity of 10 m/s. the Turbine has diameter of 120 m and its operating speed in 40 rpm at maximum efficiency. Calculate:
  - a. the total power density in the wind stream,
  - b. the maximum obtainable power density assuming  $\eta = 40\%$  ,
  - c. the total power produced(in kW) and
  - d. the torque and the axial thrust. (5 marks)
3. Make a case study for the energy required for cooking food pumping water from well in a village in India using solar energy discussing the salient features, comparative study with other source of energy:- (5 marks)
4. Compare the source of energy available by Solar and Wind in India: - (4 marks)

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**TEST – 1(CLOSED BOOK)**

**Date: 09-03-2008; Duration: 50 min.; Maximum Marks: 25, Weightage 25%**

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*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. What are the *Conventional* and *Non-conventional* energy sources?  
Describe briefly:- (3 marks)
  
2. What is meant by *Renewable energy* sources? Explain in brief these energy sources with special reference to Indian context? (3 marks)
  
3. What are the advantages and limitations of *Renewable energy* sources? (3 marks)
  
4. Define the following terms:
  - a) Hour angle
  - b) Solar azimuth angle
  - c) Incident angle
  - d) Declination angle(4marks)
  
5. Estimate the *daily global radiation* on a horizontal surface at Baroda ( $22^{\circ}13'N$ ,  $73^{\circ}13'E$ ) during the month of March. If constants  $a$  and  $b$  are given 0.28 and 0.48 respectively and average sunshine hours for day are 9.5 (6 marks)
  
6. Calculate the *sun set hour angle* and day length at location latitude of  $35^{\circ} N$  on 14<sup>th</sup> February (6 marks)