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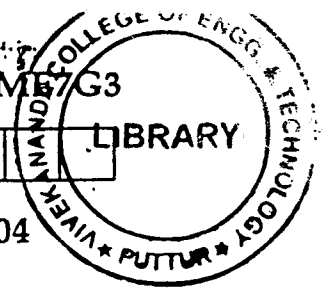
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Seventh Semester B.E. Degree Examination, May/June 2004

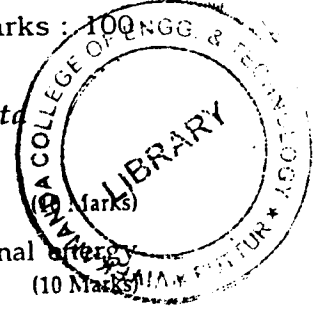
Mechanical Engineering

Non-conventional Energy Resources

Time: 3 hrs.]

(Max.Marks : 100)

Note: 1. Answer any FIVE full questions.
 2. Use of thermodynamic data and book, heat transfer data hand book permitted.



1. (a) With the help of graphs and statistics discuss India's energy scenario. (9 Marks)
- (b) With the help of statistics discuss the role of any two non-conventional energy sources suitable for India. (10 Marks)
2. (a) With a neat sketch explain the working of pyrhelimeter. (6 Marks)
- (b) Explain with appropriate sketch the apparent motion of sun. (6 Marks)
- (c) Find the height of the water tank from the ground level, if the shadow cast by it is 6m on 15th August at 10.00 AM (IST). The equation of time correction is -4 minutes. The tank is located at Belgaum ($74^{\circ}E, 17^{\circ}N$). (5 Marks)
3. Write short notes on the following : (20 Marks)
 - i) Solar air heaters
 - ii) Concentrating collectors
 - iii) Solar pond operational problems
 - iv) Principle of photo voltaic conversion.
4. (a) Data for a liquid flat plate collector are given below :
 - i) Location ; $74^{\circ}E, 17^{\circ}N$
 - ii) Day and time ; 22nd March 15:00 (LAT)
 - iii) Intensity of beam radiation : $560W/m^2$
 - iv) Intensity of global radiation ; $800W/m^2$
 - v) Collector tilt; latitude $+15^{\circ}$.
 - vi) Orientation; Due south
 - vii) Number of glass covers : 2
 - viii) Collector heat removal factor 0.82
 - ix) Average absorptance of plate : 0.93
 - x) Average transmittance of glass cover : 0.88
 - xi) Overall loss coefficient of collector : $5W/m^2K$
 - xii) Fluid inlet temperature : $60^{\circ}C$
 - xiii) Ambient temperature : $25^{\circ}C$.

Calculate

- i) Solar altitude angle
- ii) Incident angle
- iii) Hourly radiation on collector
- iv) Instantaneous efficiency

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5. (a) Explain the effect of following parameters on performance of flat plate collector.

- i) Spacing
- ii) Collector tilt
- iii) Fluid inlet temperature
- iv) Number of covers

(6 Marks)

(b) A flat plate collector is made up of a G.I absorber plate, GJ tubes fixed on the underside and two glass covers. The following data is given.

Length of absorber plate	= 1.5m
Width of absorber plate	= 1.0m
Location of collector	= Pune ($18^{\circ}32'N, 73^{\circ}51'E$)
Data	= May 15
Time	= 11 am (IST)
Collector Tilt	= Latitude Angle
Surface Azimuth Angle	= 0°
I_b	= $665w/m^2$
I_d	= $230w/m^2$
Water flow rate	= $70kg/hr$
Water Inlet temperature	= $60^{\circ}C$
Ambient temperature	= $25^{\circ}C$
Overall loss coefficient	= $4.605w/m^2 - k$
Collector efficiency factor	= 0.8824

Determine

- i) Water outlet temperature
- ii) Instantaneous efficiency

(12 Marks)

6. (a) Show the forces acting on a wind turbine blade (HAWT). (4 Marks)

(b) Wind at 1 standard atmospheric pressure and $15^{\circ}C$ temperature has a velocity of $10m/sec$. The turbine has diameter of $120m$ and its operating speed $40rpm$. at maximum efficiency

Calculate :

- i) The total power density in the wind stream
- ii) The maximum obtainable power density assuming $\eta = 40\%$
- iii) The total power produced (in kW) and
- iv) Torque and axial thrust at maximum efficiency.

(5 Marks)

(c) Explain the working of double basin Tidal power plant with the help of a neat sketch. (5 Marks)

7. (a) Explain the methods of maintenance of Biogas production. (11 Marks)

(b) What are the problems associated with OTEC ? (11 Marks)

8. (a) Explain the photo-electrolysis method of production of hydrogen. (11 Marks)

(b) Write short notes :

- i) Hydrogen transportation
- ii) Environmental effects of geothermal steam plant

(5-5 Marks)

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Semester B.E. Degree Examination, January/February 2008

Mechanical Engineering

Non-conventional Energy Resources

[Max. Marks : 100]

- Note: 1. Answer any FIVE full questions.
 2. Use of thermal data hand book, solar table and handbook permitted.

1. (a) List the advantages and limitations of various non-conventional energy resources. (10 Marks)

- (b) Explain the following :
- i) Solar constant
 - ii) Extra terrestrial radiation
 - iii) Global radiation
 - iv) Air mass
 - v) Spectral distribution of radiation

(10 Marks)

2. (a) Define the following terms :

- i) Solar altitude angle
- ii) Solar time
- iii) Solar Azimuth angle

(6 Marks)

(b) Calculate angle made by the beam radiation with the normal to a flat-plate collector, pointing due south located in New Delhi ($28^{\circ}38'N$, $77^{\circ}47'E$) at 0830 hrs. IST on December 1. The collector is tilted an angle of 36° with the horizontal. Take equation of time correction as 12 & standard time longitude as $82.50^{\circ}E$. (10 Marks)

(c) What are the tilt factors for various components of radiation ? Explain them in brief. (4 Marks)

3. (a) Explain the various operational problems associated with solar pond. (10 Marks)

(b) What are the properties required in a latent heat storage material ? (6 Marks)

(c) Draw IV characteristic of a solar cell and explain the concept of fill factor. (4 Marks)

4. (a) Explain the following terms :

- i) Stagnation temperature
- ii) Instantaneous efficiency
- iii) Selective surface
- iv) Collector heat removal factor
- v) Temperature distribution in a collector plate

(11 Marks)

(b) Calculate the transmittance - absorptance product for beam radiation falling on a flat plate collector with two glass covers each 4mm thick. The incidence angle is 30° and the value of the extinction coefficient is $0.15m^{-1}$. Let the value of α for the absorber plate to be 0.86 and the refractive index to be 1.526. Glass to air. The value of diffuse reflectivity is 0.22. (10 Marks)

6. (a) Wind at a velocity of 10m/sec , flows through a horizontal wind turbine having a diameter of 50m . Calculate

- i). Total power density in wind stream.
- ii) Total power produced from the turbine.

Take : $C_p = \text{coefficient of performance} = 0.4$

$$\gamma_{\text{generator}} = 0.9$$

$$\gamma_{\text{mech}} = 0.7$$

$$\rho_{\text{air}} = 1.2\text{kg/m}^3$$

(6 Marks)

(b) What is "energy plantation" ? What are its advantages and limitations. (6 Marks)

(c) Explain how biogas is produced from organic waste by anaerobic fermentation. (5 Marks)

7. (a) Explain the working of OTEC plant. (10 Marks)

(b) What are the different methods of production of hydrogen ?

Explain any one method of production of hydrogen. (10 Marks)

8. (a) What is geothermal energy ? Sketch and explain vapour dominated geothermal power plant. (10 Marks)

(b) What is tidal energy? Explain with a neat sketch the working of a double basin tidal power plant. (10 Marks)

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Seventh Semester B.E. Degree Examination, May/June 2005

Mechanical Engineering
Non-conventional Energy

3 hrs.]

[Max. Marks : 100

- Note: 1. Answer any FIVE full questions.
 2. Draw neat sketches wherever required
 3. Heat transfer data hand book allowed.

1. (a) What are renewable energy sources ? Explain in brief the main renewable energy sources that can be harnessed with reference to Indian context ? (10 Marks)
- (b) What is solar pond? Explain with sketches the working principle of a solar pond. Explain its operational and maintenance problems. (10 Marks)
2. (a) Determine the local apparent time (*LAT*), corresponding to 10 hrs (I.S.T) at Mangalore ($12.91^{\circ}N$, $74.86^{\circ}E$) on April 4th. In India standard time is based on $82.5^{\circ}E$. Assume equation of time correction = +4 minutes on April 4th. (6 Marks)
- (b) What are the main components of a flat plate collector. Explain the function of each part with a neat sketch. (7 Marks)
- (c) Explain with a neat sketch the working principle of a pyrheliometer. (7 Marks)
3. (a) Calculate the angle made by the beam radiation with the normal to a flat plate collector on December 8th at 8 hrs local apparent time. The collector is located at Bangalore ($12.92^{\circ}N$, $77.5^{\circ}E$) and is tilted at an angle of 15° with horizontal and is pointing due south. (10 Marks)
- (b) What are concentrating collectors ? Explain any two types of concentrating collector with sketches. (10 Marks)
4. (a) Discuss the effect of the following parameters on the performance of a solar collector.
 - i) Selective surface (10 Marks)
 - ii) Collector tilt (10 Marks)
- (b) Discuss the overall loss coefficient and heat transfer correlations for a liquid flat plate collector. (10 Marks)
5. (a) Mention different types of biogas plants. Explain any one type with a neat diagram. (10 Marks)
- (b) Describe the working principle of a single crystalline silicon cell. (10 Marks)

Use the following correlations:

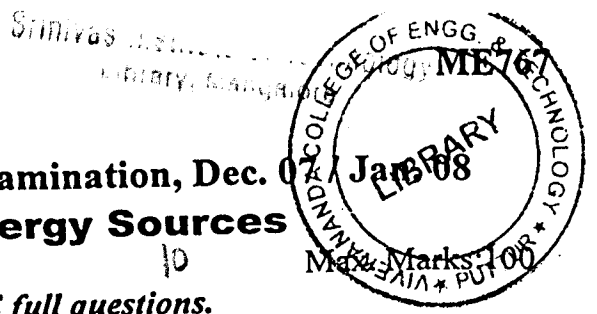
$$F' = \frac{1}{WU_1 \left[\frac{1}{U_1[(W - D_0)\phi + D_0]} + \frac{\delta_a}{K_a D_0} + \frac{1}{\pi D_e h_f} \right]}$$

$$F_R = \frac{\dot{m}C_p}{U_1 A_p} \left[1 - \text{Exp} \left\{ \frac{-F' U_1 A_p}{\dot{m}C_p} \right\} \right]$$

(15 Marks)

- b. With suitable graph, briefly explain the effect of collector tilt angle on the instantaneous efficiency of liquid flat plate collector. (05 Marks)
- 5 a. Explain the iterative method of calculation of top loss coefficient of liquid flat plate collector. (06 Marks)
- b. Calculate the transmittance – absorptance product for diffused radiation for a flat plate collector with two glass covers each 3 mm thick. The value of extinction coefficient is 0.12 /cm. Take the value of absorptivity of the absorber plate to be 0.82 and the refractive index to be 1.52. (08 Marks)
- c. Write a short note on selective surface. (06 Marks)
- 6 a. Write a note on availability of wind energy in India. (06 Marks)
- b. Describe a typical tidal power plant with a neat sketch. (08 Marks)
- c. Explain briefly with a neat sketch horizontal axis windmill. (06 Marks)
- 7 a. Discuss the role of energy plantation in solving the energy problem of India. (06 Marks)
- b. With a neat sketch explain the KVIC biogas plant. (08 Marks)
- c. List the merits and limitations of OTEC system. (06 Marks)
- 8 Write short notes on the following:
- Hydrogen transportation
 - Electrolysis of water
 - Merits of hydrogen energy
 - Scope of geothermal energy in India
 - Hot rock type geothermal power plant.

(20 Marks)



Seventh Semester B.E. Degree Examination, Dec. 07
Non Conventional Energy Sources

3 hrs.

- Note :** 1. Answer any FIVE full questions.
2. No data hand books are allowed.
3. Sketches should be neat and proportionate.

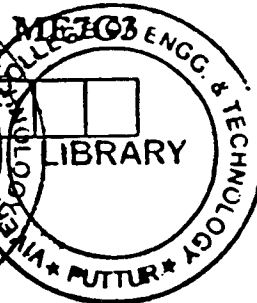
- 1 a. What is energy? Classify the different forms of energy. Briefly comment on the energy options available in India. (10 Marks)
b. Discuss the advantages of renewable energy sources over conventional energy sources. (05 Marks)
c. Calculate the angle made by beam radiation with the normal to a flat collector on December 1, at 9.00 a.m. solar time for a location at $28^{\circ} 35' N$. The collector is tilted at an angle of latitude plus 10° , with the horizontal and is pointing due south. (05 Marks)
- 2 a. With relevant figures define the following :
i) Declination
ii) Solar altitude
iii) Hour angle
iv) Solar Azimuth angle
v) Zenith angle. (10 Marks)
b. With a neat sketch explain the working of an instrument used to measure global radiation of solar energy. (10 Marks)
- 3 a. Discuss a method of large scale electricity generation using solar energy. (10 Marks)
b. Describe the principle of working of a solar pond. (10 Marks)
- 4 a. Briefly explain the factors affecting the performance of flat plate collector. (20 Marks)
- 5 a. Write a short note on principle of photo voltaic conversion. (05 Marks)
b. With a neat sketch explain horizontal axis wind turbine. (05 Marks)
c. Wind at 1 std atmospheric pressure and $15^{\circ} C$ has velocity of 15 m /s. Calculate
i) The total power density in the wind stream
ii) The maximum obtainable power density
iii) A reasonably obtainable power density
iv) The total power
v) The torque and axial thrust.
Given : turbine diameter = 120m. and turbine operating speed = 40 rpm at maximum efficiency, [for air, the value of gas constant $R = 0.287 \text{ kJ /kg K}$
 $1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa}$] (10 Marks)
- 6 a. Describe the working of a tidal power plant working under single basin operation. (06 Marks)
b. Explain with a neat sketch the principle of working of OTEC. (07 Marks)
c. With neat sketch explain the working of "Hot dry rock" geothermal plant. (07 Marks)
- 7 a. Write a note on process of digestion. (06 Marks)
b. List the factors affecting the biogas generation. (04 Marks)
c. Explain with a neat sketch how biogas is produced in an Indian type biogas plant. (10 Marks)
- 8 a. With a neat sketch explain the electrolytic production of Hydrogen. (10 Marks)
b. Explain the different method of hydrogen storage. (10 Marks)

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Seventh Semester B.E. Degree Examination, **May 2002**
Mechanical Engineering
Non-Conventional Energy Resources

[Max. Marks:100]

Time: 3 hrs.]

Note : Answer any FIVE full questions.

- a. With the help of statistics discuss India's production and reserves of coal and nuclear fuel. (10 Marks)
- b. With the help of a neat sketch explain the working principle of sunshine recorder. (05 Marks)
- c. Explain with graph, the spectral distribution of extraterrestrial radiation. (05 Marks)
- a. Calculate the length and direction of the shadow cast on the ground by a 1 m long vertical stick fixed on the floor for the following situation:
 - Location: Simnagar ($34^{\circ}06' N, 74^{\circ}51' E$)
 - Date: Feb 13, 2002
 - Time: 10:00 AM (IST)
 - Time correction: -14 min. (10 Marks)
- b. Explain the apparent motion of sun. (04 Marks)
- c. Explain the following: (06 Marks)
 - i) Tilt factor for beam radiation
 - ii) Tilt factor diffused radiation.
- a. Write short notes on the following: (12 Marks)
 - i) Solar passive system of house heating and cooling.
 - ii) Photovoltaic conversion.
- b. Explain the application of solar energy for refrigeration and water distillation. (08 Marks)
- a. A liquid flat plate collector for heating water is made of G.I. sheet with integral inline tubes and is located facing due south. Calculate the collector efficiency and the fluid outlet temperature for the following data:
 - Collector area: 1.5 m^2
 - Tube diameters: 14 mm ID, 18 mm OD
 - Tube center to center distance: 120 mm
 - Location: $14^{\circ} N, 75^{\circ} E$
 - Date and time: 15 May at 11:00 h (LAT)
 - Plate effectiveness: 0.9
 - Collector tilt: latitude of location $+10^{\circ}$
 - Water flow rate: 1.2 kg/min.
 - Average transmittance – absorptance product: 0.75
 - Bond resistance: negligible
 - Overall loss coefficient: $4.5 \text{ W/m}^2\text{K}$
 - Tube to fluid heat transfer coefficient: $200 \text{ W/m}^2\text{K}$
 - Intensity of global radiation: 850 W/m^2
 - Intensity of diffused radiation: 250 W/m^2
 - Water inlet temperature: 50°C
 - Ambient temperature: 30°C
 - Number of glass covers: 2