

IV B.Tech I Semester Regular Examinations, November 2006  
NON-CONVENTIONAL SOURCES OF ENERGY  
( Common to Mechanical Engineering, Mechatronics and Production  
Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
All Questions carry equal marks

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1. Explain the followings:
  - (a) Beam and diffus solar radiation
  - (b) The hour angle
  - (c) The Sun's declination
  - (d) The latitude and longitude [6+3+3+4]
2. (a) Define collection efficiency of a flat plate collector. What are the parameters on which it depends?  
(b) What are the main measuring instruments used for testing the solar collectors? Describe in brief. [8+8]
3. (a) List out the advantages of photo-voltaic solar energy conversion.  
(b) How can solar energy can be stored in the form of thermal energy? Explain and discuss in brief. [10+6]
4. (a) Neglecting losses, determine the maximum power that can be extracted by a wind mill from a steady wind of 5 m/s. Assume a wind mill rotor diameter of 25m, with air density  $1.2\text{Kg}/\text{m}^3$ . Find the pressure decrease across the rotor.  
(b) How do you classify wind mills? Explain about any one type with neat sketches. [8+8]
5. (a) Explain the classification of biomass resources.  
(b) How the biomass conversion takes place? What is the difference between biogas and biomass? [8+8]
6. (a) What are liquid dominated hydrothermal convective systems? Write about them.  
(b) With the help of a neat diagram, explain the working of a liquid dominated double flash steam system. [6+10]
7. (a) Explain with neat sketches the various methods of tidal power generation. What are the limitations of each method?  
(b) What are the advantages, limitations and operational difficulties encountered in OTEC plants? [10+6]

Code No: RR410307

**Set No. 1**

8. Describe the operation of a thermionic converter.

[16]

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1. Define the followings:
  - (a) Solar azimuth angle
  - (b) angle of incidence
  - (c) solar azimuth angle
  - (d) sunrise, sunset and daylength. [4×4]
  
2. Estimate collector efficiency at 10 am on June 22 for a flat plate collector located at Poona ( $\phi = 18.29'N$ ) and tilted towards the equator with a slope equal to the latitude. The measured total insolation is  $600W/m^2$ . For the collector, assume  $U_L = 6W/m^2C$ , fluid to tube heat transfer coefficient is  $1000W/m^2C$ , aluminium fins and tube type construction, tube centre to centre distance of 15 cm, fin thickness of 0.05 cm, tube outside diameter of 1.5 cm, inside diameter 1 cm, cover transmittance for solar radiation is 0.9 and independent of direction, solar absorptance of absorbing plate is 0.95, collector width is 1 m and length is 3 m, water flow rate is 75 kg/hr, water inlet temperature is constant and is equal to 60 C. Ambient temperature may be assumed to 25 C. [16]
  
3. (a) With a neat sketch, explain the suitability of solar dryer for the products like Tea and Tobacco.  
(b) With a neat sketch, explain the working of solar water heater. [8+8]
  
4. (a) Prove that the maximum power coefficient ( $C_p$ ) for a wind mill is 0.593.  
(b) How are the wind mills classified? [12+4]
  
5. What are the applications of biogas? Can it be used as a fuel in IC engines? What are the modifications required in the regular SI and CI engines to adapt biogas as a fuel. Is it economical to use it for IC engines? [16]
  
6. (a) What is geothermal energy? Explain.  
(b) Give the classification of different geothermal sources in detail. [6+10]
  
7. (a) With reference to neat layout diagrams, explain the operation of a closed cycle OTEC plant.  
(b) Find the quantity of water to be pumped to OTEC plant working with surface water at 27 C and with cold water at 8 C at a depth of 600 m from the surface to obtain 1.0 MW of thermal energy. Assume the density of ocean water as  $1010 kg/m^3$  and the specific heat of water as 4200 J/kg K. [8+8]

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**Set No. 2**

8. (a) Discuss the direct and indirect energy conversion systems emphasizing on the advantages and limitations of each.
- (b) How is the operation of thermoelectric generator different from that of conventional generators? [12+4]

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1. (a) Define solar constant.  
(b) Determine for the following atmospheric conditions, the atmospheric total transmittance for scattering only, when the sun is at zenith.  
Wave length =  $0.5\mu m$   
Total pressure = 750 mm of Hg.  
Dust particle concentration at the ground particles =  $800/cm^3$   
Depth of perceptible water = 20mm  
Assume monochromatic atmospheric transmittance  
Considering absorption only which is = 0.6. [4+12]
  
2. Write short notes on:
  - (a) Selecting absorber coatings
  - (b) Materials for flat plate collectors
  - (c) Evacuated solar collectors [5+5+6]
  
3. (a) Discuss in detail about the mechanism of salt-gradient solar pond, with the aid of neat sketches.  
(b) Discuss the following
  - i. packed bed storage system,
  - ii. Photo-voltaic cell. [8+8]
  
4. (a) How do you measure the speed and the direction of a wind? Explain in detail.  
(b) What are the various characteristics of the wind? Discuss them in detail. [9+7]
  
5. Explain in detail about the factors which affect the bio-digestion. [16]
  
6. (a) What are liquid dominated hydrothermal convective systems? Write about them.  
(b) With the help of a neat diagram, explain the working of a liquid dominated double flash steam system. [6+10]
  
7. (a) Explain with a neat sketch the energy extraction techniques from tidal waves.  
(b) The efficiency of power plant working on OTEC system is very less. However, the secondary advantages make it commercially attractive. Discuss. [8+8]

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**Set No. 3**

8. Describe the operation of a thermionic converter.

[16]

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1. (a) With neat diagram, explain the working of sun-shine recorder.  
(b) Write short notes on solar radiation data. [10+6]
2. Estimate collector efficiency at 10 am on June 22 for a flat plate collector located at Poona ( $\phi = 18.29'N$ ) and tilted towards the equator with a slope equal to the latitude. The measured total insolation is  $600W/m^2$ . For the collector, assume  $U_L = 6W/m^2C$ , fluid to tube heat transfer coefficient is  $1000W/m^2C$ , aluminium fins and tube type construction, tube centre to centre distance of 15 cm, fin thickness of 0.05 cm, tube outside diameter of 1.5 cm, inside diameter 1 cm, cover transmittance for solar radiation is 0.9 and independent of direction, solar absorptance of absorbing plate is 0.95, collector width is 1 m and length is 3 m, water flow rate is 75 kg/hr, water inlet temperature is constant and is equal to 60 C. Ambient temperature may be assumed to 25 C. [16]
3. (a) With a neat sketch, explain the suitability of solar dryer for the products like Tea and Tobacco.  
(b) With a neat sketch, explain the working of solar water heater. [8+8]
4. Determine the wind mill rotor diameter to operate a centrifugal pump, which will have a discharge of 40,000 litres/day with a total head of 10 m. The pump operates for 10 hours in a day. The rated speed of wind is 6 m/s. The power coefficient is 0.3. Density of air is  $1.2Kg/m^3$ . Assume transmission efficiency 95%, Pump efficiency as 35%. [16]
5. (a) Write about different materials used for biogas generation?  
(b) What is meant by wet fermentation and dry fermentation? Explain. [8+8]
6. (a) What are liquid dominated hydrothermal convective systems? Write about them.  
(b) With the help of a neat diagram, explain the working of a liquid dominated double flash steam system. [6+10]
7. (a) Explain with neat sketches the various methods of tidal power generation. What are the limitations of each method?  
(b) What are the advantages, limitations and operational difficulties encountered in OTEC plants? [10+6]

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**Set No. 4**

8. (a) Discuss the direct and indirect energy conversion systems emphasizing on the advantages and limitations of each.
- (b) How is the operation of thermoelectric generator different from that of conventional generators? [12+4]

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