BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR, HOW-3
B.E.(Mech) Part-IV 7th Semester Final Examination, 2013.

Subject : Solar Energy Thermal Processes (Elective – I) Paper Code : ME-705/9
Branch : Mech. Engg.
Time : 3 hours Full Marks : 70

Answer FIVE questions
The questions are of equal value

1 (a) State in brief the basic principles used in wind energy conversion system. Also mention its merits and demerits. Mention the range of magnitudes of few important design parameters used in practice.

(b) A wind energy conversion system operates at wind turbine at 52 rpm. Atmospheric pressure and temperature are 1bar and 295 K. Calculate (i) maximum power density, (ii) actual power produced by the turbine and (iii) maximum axial and tangential thrusts generated in the system.. Actual efficiency of the machine is 22 %. Incoming wind speed is 14 m/sec and characteristic gas constant of air is 0.287 kJ/Kg-K. The turbine blade diameter is115m.

2 (a) Discuss in brief the basic principles used for a MHD power generator. Write the expression for computing the power generated per unit length with physical significance of the terms used in the expression with respect to its practical use. With the help of a diagram, discuss in brief the working of the system.

(b) With the help of a neat labeled diagram, state in detail the functioning of an open cycle OTEC system.

3 (a) State Seebec and Peltier effects utilized for a thermo-electric generator. Deduce the expressions for heat addition and heat rejection of the said generator.

(b) A thermo-electric generator is operating between the temperatures of $880^0$c and $175^0$c respectively. It operates at maximum thermal efficiency. Calculate (i) maximum value of figure of merit, (ii) number of couples in series, (iii) heat addition to and heat rejection from the generator in load and no load conditions in kW and (iv) maximum thermal efficiency. Assume that the generator produces 92 kW at 110 V. The properties of thermoelemnts are as, Seebeck coefficient – 0.0011 V/K; Thermal conductivity – 0.032 W/cm-K; Electric resistivity – 0.014 ohm-cm. Ratio of cross sectional area and length of both thermoelements is 92.

4 (a) With the help of neat labeled diagram, explain in brief the functioning of each component of a flat plate collector. Mention the typical salient data used for different components of the flat plate collector of a solar water heater with a capacity of 100 lits per day.

(b) Deduce the expressions for different loss coefficients of a flat plate collector with single transparent cover. Mention each terms of the deduced expressions along with their significance.

5 (a) Discuss in brief the basic principle of a thermionic power generating system. Deduce the expression for its efficiency.

(b) A thermionic power generating system operates at maximum thermal efficiency with its cathode and anode temperatures of $120^0$c and $900^0$c respectively. Estimate (i) power output per unit area, (ii) thermal efficiency and (iii) emitter area in $cm^2$. It produces power of 68 kW. Assume e = 1.602 x $10^{-5}$Coulomb; K = 1.38 x $10^{-23}$ J/molecules-K; for cathode and anode (eV/KT) as 16; emission factor as 115 amps/ $cm^2 - K^2$.

6 Write short notes on any FOUR of the following :

(i) Basic principle of fuel cell
(ii) Natural circulation solar water heating system
(iii) Estimation of pressure difference across the wind rotor
(iv) Solar cooker
(v) Corrosion in a solar collector and the procedures used for its performance enhancement