Centre for Energy Studies
Indian Institute of Technology
Energy Conservation and Management (ESL 350)
Minor-II
Attempt All Questions

MM: 32+1=33

Q.1(a): What is the thermodynamic view of Energy Conservation and energy efficiency? State daily life application of exergy concept. **(4)**

Q.1(b): Define any of the **TWO** from the followings:

1) Energy, Exergy and Lethargy
2) Direct and indirect gain passive solar heating of building
3) Economic thickness of insulation

(2x3 = 6)

Q.2(a): Define second law efficiency in different forms and write down second law efficiency of the turbine/nozzle, compressor/diffuser, and heat exchanger from exergy balance equation for a thermal flow system.

(6)

OR

Using the proper diagram, drive the expression for heat flux across a composite wall having three different layers of different thickness L_A, L_B, L_C (in m) and thermal conductivity of k_A, k_B, and k_C (W/m-K) respectively. The wall is exposed to ambient air on one side and the living room on another side having the convective and radiative heat transfer coefficients of h_{co} h_{ci} and h_{ri}, respectively. Also define the U-value for the wall and draw the equivalent thermal circuit analogous to electrical circuit.

(6)

Q.2(b): A flow of hot water at 90 °C is used to heat relatively cold water at 25 °C up to a temperature of 60 °C in a heat exchanger. The cold water flows at a rate of 1 kg/s, when the heat exchanger is operated in parallel flow mode, the exit temperature of the hot water stream must be less than 60 °C. In the counter flow operating, the exit temperature of hot water can be as low as 35 °C. Compare the second law efficiency and the rate of exergy destruction in the two mode of operation (given T_0 = 300 K).

(6)

Q.3(a): Define thermal and pressure drop irreversibilities and obtain analogy between them.

(6)

OR

Drive the expression for entropy generation number in a mixing chamber and state the condition of the minimum entropy generation.

(6)

Q.3(b): Water at 90 °C flowing at 2 kg/s is mixed adiabatically with water at 30 °C flowing at 1 kg/s while the ambient temperature is 300 K and the pressure drop is negligible. Calculate the entropy generation rate and the rate of Exergy loss due to mixing process (C_{pw} = 4.187 kJ/kg-K).

(4)