Q.P.CODE: 26759

(TIME: 3 hour) **[Total marks:80]**

N.B.:

1. **Question-1 is compulsory. Answer any three questions from remaining**
2. **Assume data if necessary and specify the assumptions clearly**
3. **Draw neat sketches wherever required**
4. **Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other**

1 a) Discuss "energy profile" **(5)**

b) Explain the concept of "optimum approach temperature difference (ΔT_{opt})" in heat exchanger networking **(5)**

c) Discuss direct and indirect benefits of waste heat recovery (WHR) **(5)**

d) Differentiate between primary and secondary energy sources with examples **(5)**

2 a) Explain how to make "motor, belts and drives system" of process plant more efficient **(12)**

b) Discuss different types of "energy sub audits" **(8)**

3 a) Derive basic rule of heat exchanger networking by Linhoff to match the streams on hot and cold side of pinch **(10)**

b) Estimate minimum utility requirement of hot and cold and pinch temperature for the process stream given below: **(10)**

ΔT_{min}=30°C

Stream	T^s(°C)	T^t(°C)	mCp (KW/°C)
1	140	70	3
2	100	40	5
3	60	80	6
4	30	120	4

4 a) A triple effect evaporator is concentrating a liquid that has no appreciable elevation in boiling point. The temperature of steam to the first effect is 108°C, and the boiling point of the solution in the last effect is 52°C. The overall heat transfer coefficients, in W/m^2°K are 2500 in the first effect, 2000 in the second effect and 1500 in the third effect. At what temperatures will the liquid boil in the first and second effects? **(10)**

b) Explain how multiple effect evaporator is more advantageous over single effect evaporator **(5)**

c) Write short note on multiple effect distillation **(5)**

5 a) The potential for electricity generation (PGC) for a steam turbine system is 18,500 kW. The saturated steam is being expanded through a PRV to obtain process steam Determine :- **(8)**

I. Theoretical steam rate (TSR) in lb/kW-hr

II. Steam flow rate (Ws) in lb/hr

Data :-

Inlet enthalpy of steam (hi)= 1378.9 Btu/lb

Outlet enthalpy of steam (ho)= 935.0 Btu/lb

Efficiency of turbine generator ($\eta tg = 0.77$)

b) Discuss topping cycle and bottoming cycle with suitable example **(12)**

6 Write short notes on:

a) Waste heat boiler **(5)**

b) Vapor recompression related to distillation **(5)**

c) Economizer **(5)**

d) Reboiler flashing **(5)**

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