

Time: 3 Hours

Marks: 80

**N.B.:**

1. Question No.1 is compulsory and attempt any three questions from remaining
2. Assume data if necessary and specify the assumptions clearly
3. Draw neat sketches wherever required

**Q.1** [Compulsory Question]

- a) Distinguish between Commercial, non-commercial energy sources [4]
- b) Write short note on "Mini energy audit". [4]
- c) What is pinch temperature? What is its significance? [4]
- d) What is Cogeneration system? Give its advantages. [4]
- e) Explain direct and indirect benefit of WHR [4]

**Q.2**

- a) Explain Energy efficient technology with the help of any industrial process example. [5]

Determine the pinch temperature and the minimum utility requirement for the stream set out in the table below for a minimum temperature difference between the streams of 20 °C. Also Design a heat exchanger network to achieve the maximum heat recovery. [15]

Stream Type	Stream No	Source Temperature °C	Target Temperature °C	Heat Capacity Rate (CP) W/°C
Hot	H <sub>1</sub>	440	150	2800
Hot	H <sub>2</sub>	520	300	2380
Cold	C <sub>1</sub>	100	430	1600
Cold	C <sub>2</sub>	180	350	3270

**Q.3**

- a) State energy policies and energy rules and regulations in India. [05]
- b) A forward feed triple effect evaporator is used to concentrate dilute solution. The steam at 121°C and 4093 kg/hr is used as heating source for 1<sup>st</sup> effect, however in 2<sup>nd</sup> and 3<sup>rd</sup> effect vapour generated in previous effect are used as heating source. The latent heat of steam used in 1<sup>st</sup> effect is 2200 KJ/Kg. [15]

**Calculate**

1. Boiling Point in each effect
2. Heat transfer area in each effect and
3. steam economy

**Data:**

	Effect 1	Effect 2	Effect 3
U [W/m <sup>2</sup> K]	3100	2000	1100
$\Delta T$ [°C] adjusted for cold feed condition	18	17	34
Vapour Generated [Kg/hr]	2480	2660	2858
$\lambda$ [Kg/KJ]	2249	2293	2377

**Q.4**

- a) State Indian energy demand and supply. [5]
- b) Determine the minimum hot and cold utility requirement and pinch temperature by using composite curve for the process stream having following thermal data [15]

Stream No	Stream Type	Source Temperature °C	Target Temperature °C	Heat Capacity Flowrate (CP) W/°C
1	Hot	180	80	20
2	Hot	130	40	40
3	Cold	60	100	80
4	Cold	30	120	36

**Q.5**

- a) State and Explain the 'Heat Integration of MEE evaporator with GCC. [10]
1. Forward feed Triple effect evaporator.
  2. Backward feed Triple effect evaporator and
  3. Mixed feed Triple effect evaporator
- b) Explain in detail the energy auditor tool box [10]

**Q.6.** Write Short Note on any four of the following [20]

- a) Composite Curve
- b) Waste Heat Recovery Boiler
- c) Bottoming Cycle of Cogeneration
- d) Energy Profile
- e) Fuel Cell