

(3 Hours)**Total Marks:80****N.B.:**

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

1. (a) What is the effect of over surface area and over design in case of design of a heat exchanger? [05]
- (b) Write a note on welded plate heat exchanger [05]
- (c) What is the effect of non condensables on the rate of condensation? [05]
- (d) What are the different types of Shells in case of shell and tube heat exchanger as per TEMA standards [05]

2. (a) Enlist the different types of reboilers. Explain the working of Kettle type reboiler with neat sketch [10]
- (b) Draw the schematic of equivalent hydraulic network for shell side flow in case of stream analysis method and give the name of each stream [04]
- (c) How do you ensure negative pressure in furnace while design? [06]

3. There is a requirement to cool 20000 kg/h of condensate water from 64 °C to 46°C. Cooling water will be used for cooling, with inlet and outlet temperatures of 25 °C and 41°C. Design a gasketed-plate heat exchanger for this duty. Use stainless steel ($k= 15 \text{ W/m.K}$) plates of 0.75mm thick. Maximum operating pressure and allowable pressure for both fluids is 3 bar and 0.7 bar respectively and maximum permissible velocity is 3m/s. Show one iteration of design calculation including thermal and hydrodynamic and if design is not satisfactory in first iteration then comment on the calculations.

Given data:

Property	Cooling water	Condensate
Specific heat (kJ/kg.K)	4.179	4.183
Viscosity (cP)	0.705	0.504
Density (kg/m ³)	994	985.7
Thermal conductivity (W/m.K)	0.625	0.65

