Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course : Heat Transfer | **Semester : IV**
Program : B. Tech. (APE Gas) | **Time : 03 hrs.**
Course Code: CHCE 2023 | **Max. Marks : 100**

Instructions:

- ✓ Attempt **all** questions from **Section-A** (each carrying 4 marks), **Section-B** (each carrying 10 marks) and **Section-C** (carrying 20 marks).

Assume suitable data wherever necessary. The notations used here have the usual meanings.

SECTION-A

S. No.		Marks	CO
1.	State Fourier's law of heat conduction and Newton's law of cooling?	4 M	CO1
2.	Classify natural and forced convection? Give one example for each?	4 M	CO3
3.	Explain why drop wise condensation is preferred to film wise condensation?	4 M	CO3
4.	Explain the terms absorptivity, and emissivity	4 M	CO4
5.	Define view factor?	4 M	CO4
	SECTION-B		
6.	A steel pipe line (k= 50 W/mK) of 100 mm ID and 120 mm OD is to be covered with two layers of insulation each having a thickness of 40 mm and 50 mm. The thermal conductivity of the first insulation material is 0.05 W/mK and that of the second is 0.15 W/mK. Calculate the loss of heat per meter length of pipe and the interface temperature between the two layers of insulation when the temperature of the inside tube surface is 250 ^{o}C and that of the outside surface of the insulation is 50 ^{o}C.	10	CO2
7.	State how the heat exchangers classified? Sketch the temp variations in (i) parallel flow heat exchanger (ii) counter-flow heat exchangers (iii) Boiler (iv) Condenser	10	CO5
8.	Draw the boiling curve for pool boiling of water and explain flow regimes	10	CO3
9.	A single effect evaporator is to concentrate 9500 kg/hr of 20% solution of sodium hydroxide to 50% solids. The gauge pressure of the steam is 1.37 atm; the absolute pressure in the vapour space is 100 mmHg. The overall coefficient is estimated to be 1400 W/m^2. ^{o}C. The feed temperature is 37.8 ^{o}C. Calculate the amount of steam consumed, the economy and the heating surface required. Data:	10	CO5

	Enthalpy of 20% solution = 127.931 kJ/kg Enthalpy of 50% solution = 513.95 kJ/kg B.P. of water at 100 mmHg = 51.1 ^{o}C B.P. of solution at 100 mmHg = 91.67 ^{o}C Enthalpy of water vapour at 91.67 ^{0}C = 2672 kJ/kg Heat of vaporization of steam (B.P. 126.11 ^{0}C) at 1.37 atm(g) = 18466 kJ/kg The condensation temperature of steam= 126.1 ^{o}C		
SECTION-C			
10.	Consider a shell and tube heat exchanger constructed from a 0.0254m OD tube to cool 6.93 kg/s of a 95% ethyl alcohol solution (C_P 3810 J/kg.K) from 60 ^{o}C to 40 ^{o}C using 6.15 Kg/s of water available at 15 ^{o}C (C_P 4187 J/kg.K). In the heat exchanger 72 tubes will be used. Assume that the overall heat transfer coefficient based on the outer tube area is 650 W/m^2.K. Calculate the surface area and the length of heat exchanger for each of the following arrangement. a) Parallel flow shell and tube heat exchanger b) Counter flow shell and tube heat exchanger	**20**	**CO5**
11.	Derive an expression for three dimensional steady state heat conduction in a cylindrical coordinate system	**20**	**CO2**