Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Supplementary Examination, May 2022

Course : Heat Transfer **Semester : IV**
Program : B. Tech. (CERP) **Time : 03 hrs.**
Course Code: CHCE 2009 **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.	What are the different modes of heat transfer? Explain.	**4 M**	**CO1**
2.	Differentiate between natural and forced convection?	**4 M**	**CO1**
3.	What are the types of condensation processes? Explain.	**4 M**	**CO3**
4.	What are the different modes of heat transfer? Explain.	**4 M**	**CO1**
5.	What is LMTD correction factor?	**4 M**	**CO4**
	SECTION-B		
6.	Derive an expression for three dimensional steady state heat conduction in a Cartesian coordinate system	**10**	**CO1**
7.	Define Boiling. Draw the boiling curve for water and show different regimes on that. Explain Nucleate boiling regime and factors affecting it.	**10**	**CO3**
8.	A counter-flow double-pipe heat exchanger is to heat water from 20 ^{o}C to 40 ^{o}C at a rate of 1.2 kg/s. The heating is to be accomplished by geothermal water available at 150 ^{o}C at a mass flow rate of 2kg/s. The inner tube is thin-walled and has a diameter of 1.5cm. If the overall heat transfer coefficient of the heat exchanger is 640 W/m^{2}.^{o}C, determine the length of the heat exchanger required to achieve the desired heating.	**10**	**CO4**
9.	Derive the expression for logarithmic mean temperature difference for co-current flow heat exchanger.	**10**	**CO4**

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 66 ^oC to 42 ^oC using 6.30 Kg/s of water available at 10 ^oC (C_P 4187 J/kg.K). In the heat exchanger 78 tubes will be used. Assume that the overall heat transfer coefficient based on the outer tube area is 656 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**	**CO4**
11.	A single effect evaporator is to concentrate 8500 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. ^oC. The feed temperature is 37.8 ^oC. Calculate the amount of steam consumed, the economy and the heating surface required. Data: 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 ^oC B.P. of solution at 100 mmHg = 91.67 ^oC Enthalpy of water vapour at 91.67 ^0C = 2672 kJ/kg Heat of vaporization of steam (B.P. 126.11 ^0C) at 1.37 atm(g) = 18466 kJ/kg The condensation temperature of steam= 126.1 ^oC	**20**	**CO2**