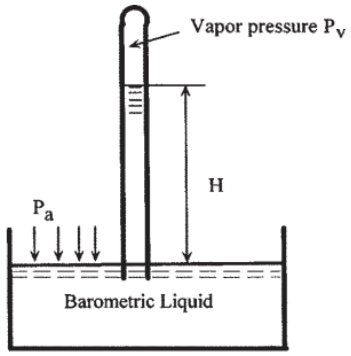
Name: Enrolment No:	UPES

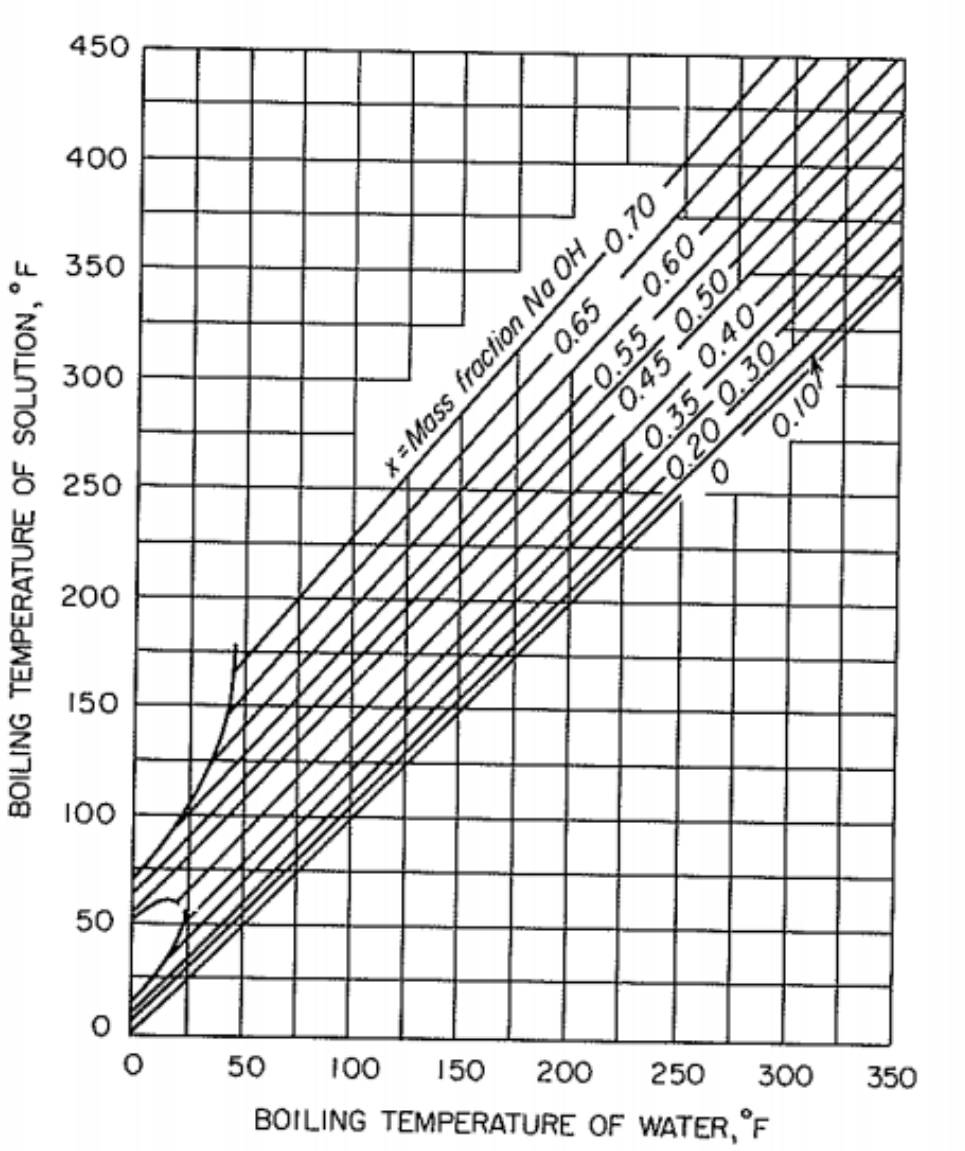
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

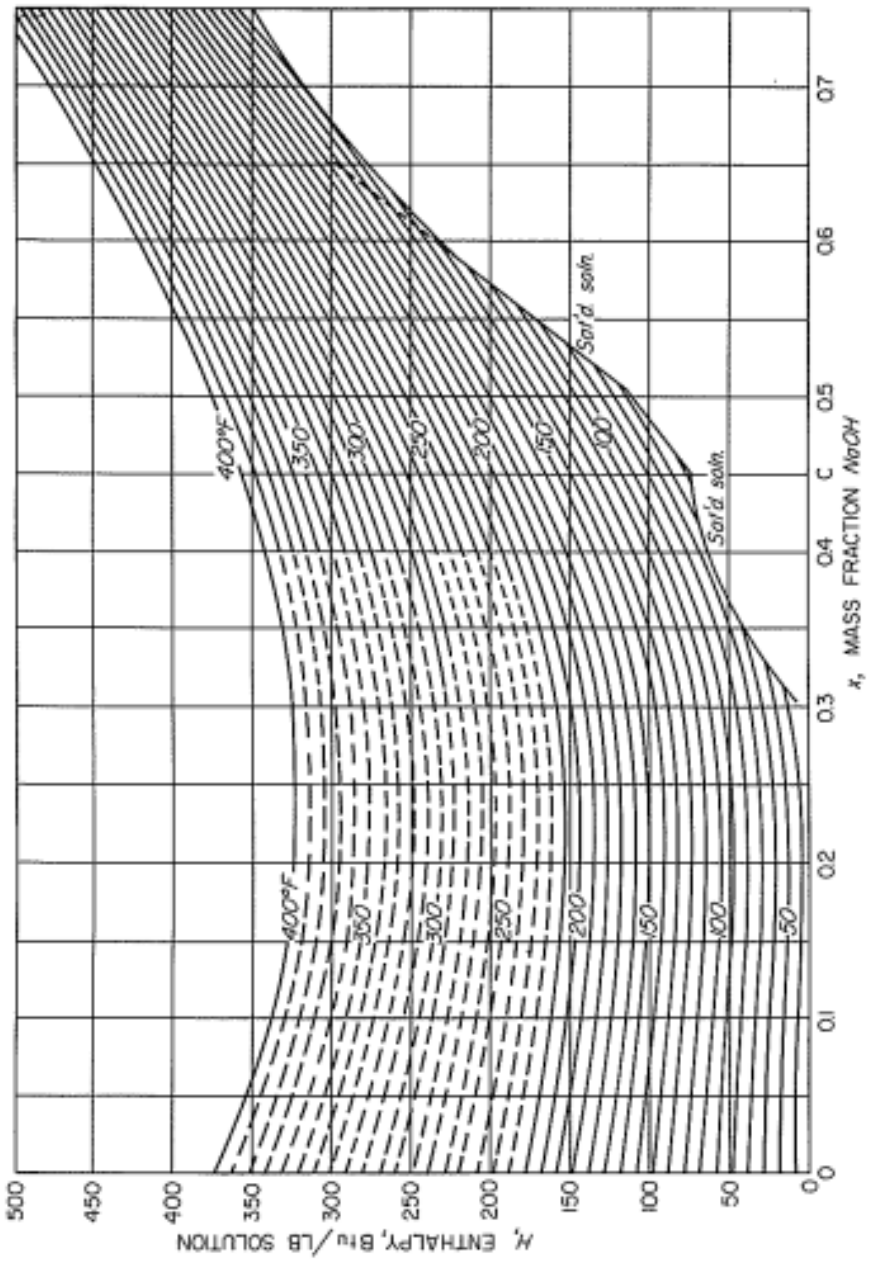
End Semester Examination, Nov-Dec 2021

Programme Name: M.Tech PDE **Semester :** 1st
Course Name : Fluid Flow and Heat Transfer Equipment **Time :** 03 hrs.
Course Code : CHPD7005 **Max. Marks:** 100
Nos. of page(s) : 02
Instructions :

SECTION A

S. No.		Marks	CO
1	Explain the differentiation for Newtonian and Non Newtonian fluid with proper example	4	CO1
2	What are the various criteria considered for piping design?	4	CO1
3	What is Pinch technology and why it is required?	4	CO2
4	Discuss briefly the different feed scheme for evaporators.	4	CO2
5	What are the different application areas of furnace?	4	CO2
SECTION B			
6	Derive the equation for mass conservation from the Reynold Transfer Theorem	10	CO3
7	Assume the vapor pressure of water at 70°F is 0.3632 psi and its specific weight is 62.3 lb/ft3. Mercury has a specific gravity of 13.54 and negligible vapor pressure. The sea level atmospheric pressure is 14.7 psi. Determine the barometric heights (in ft) for water and mercury. Use the following figure for the calculation 	10	CO3
8	Discuss the different flow patterns of single-phase fluid in a shell and tube heat exchanger. Draw suitable diagrams.	10	CO4
9	Derive the expression for enthalpy balance with negligible heat of dilution for a single effect evaporator.	10	CO4
SECTION C			
10	A single effect evaporator concentrates 9070 kg/hr (20000 lb/hr), 20% NaOH solution to 50% solids. Steam pressure is 1.37 atm (gauge). Vapor space pressure is 100 mm of Hg in absolute scale. Overall heat transfer coefficient is 1400 W/m2 ^{0}C (250 Btu/ft^{2}hr^{0}F). Feed is at 38 ^{0}C (100 ^{0}F). Calculate the economy, heating surface area	20	CO5

	and steam consumed. Assume the enthalpy of superheated steam as 1150 Btu/lb. Use the below data  		


h, ENTHALPY, Btu/LB SOLUTION
x, MASS FRACTION NaOH
Sat'd soln.
Sat'd soln.
400°F
350
300
250
200
150
100
50
400°F
350
300
250
200
150
100
50
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
C
500
450
400
350
300
250
200
150
100
50
0

Temperature T, °F	Vapor pressure p_A, $lb_f/in.^2$	Specific volume, ft^3/lb		Enthalpy, Btu/lb		
		Liquid v_x	Saturated vapor v_y	Liquid H_x	Vaporization λ	Saturated vapor H_y
120	1.6945	0.016205	203.0	88.00	1025.5	1113.5
130	2.225	0.016247	157.17	97.98	1019.8	1117.8
140	2.892	0.016293	122.88	107.96	1014.0	1121.9
150	3.722	0.016343	96.99	117.96	1008.1	1126.1
160	4.745	0.016395	77.23	127.96	1002.2	1130.1
170	5.996	0.016450	62.02	137.97	996.2	1134.2
180	7.515	0.016509	50.20	147.99	990.2	1138.2
190	9.343	0.016570	40.95	158.03	984.1	1142.1
200	11.529	0.016634	33.63	168.07	977.9	1145.9
210	14.125	0.016702	27.82	178.14	971.6	1149.7
212	14.698	0.016716	26.80	180.16	970.3	1150.5
220	17.188	0.016772	23.15	188.22	965.3	1153.5
230	20.78	0.016845	19.386	198.32	958.8	1157.1
240	24.97	0.016922	16.327	208.44	952.3	1160.7
250	29.82	0.017001	13.826	218.59	945.6	1164.2
260	35.42	0.017084	11.768	228.76	938.8	1167.6
270	41.85	0.017170	10.066	238.95	932.0	1170.9

11	100 000 kg/h of water is to be transferred from canal to reservoir by gravity. Maximum height of water level above the discharge of pipe in reservoir will be 2 m. Difference between minimum level of water in canal and maximum level of water in reservoir is 8 m. Length of pipe = 3000 m Equivalent length of pipe for fittings and valves = 200 m Maximum temperature of water = 40°C Density of water at 40°C = 993 kg/m3 Viscosity of water at 40oC = 0.67 mPa • s or cP Surface roughness for carbon steel, s = 0.0457 mm Surface roughness for concrete, e= 1.2 mm Material of pipe is carbon steel. Determine the suitable pipe size for carbon steel. If material of pipe is concrete, will there be any change in pipe size required? Assume the following data friction factor for Carbon steel (f) = 0.0042 friction factor for Concrete (f) = 0.0077 Pressure drop per unit length is given as $\frac{32 f G^2}{\pi^2 \rho g_c D_i^5}$ Allowable velocity = 0.5 – 1.0 m/s	**20**	**CO5**