Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2020

Course: B.Tech Chemical R&P **Semester: VII**
Program: Chemical Process Equipment Design & Drawing **Time 03 hrs.**
Course Code: CHEG 401 **Max. Marks: 100**
Nos. of page(s): 03
Instructions: Open Book exam. Data set, Tables, Charts, Figures, Calculator are allowed

SECTION A - Type the Questions

S. No.		Marks	CO
Q 1	Define Elastic Limit, Yield stress and Ultimate stress. Define the relation between yield stress and factor of design margin.	1+1+1 +3= 6	CO1
Q 2	Differential between thin vessel and thick vessel. Explain the different stresses considered for both the cases.	6	CO2
	SECTION B – Scan and Upload		
Q 3	Consider a quarter ($1/4^{th}$) filled horizontal vessel with ID = 3 m & L/D ratio = 2. No insulation is provided over the vessel surface. Consider the latent heat of vaporization of the stored material as 90 kJ/kg. Calculate the Relief Rate for Fire case scenario. Consider adequate drainage and firefighting is available.	6	CO3
Q 4	Discuss application of different pitch configurations in heat exchanger	6	CO4
Q 5	Discuss the performance diagram of a column. Explain what is internal reflux and external reflux	6	CO5
	SECTION-C – Scan and Upload		
Q 6	44000 lb/hr of a 42^0API kerosene leaves the bottom of a distillation column at 380 ^{0}F and will be cooled to 210 ^{0}F by 34 ^{0}API Mid-continent crude coming from storage at 100 ^{0}F and heated to 160 ^{0}F. A 10 psi pressure drop is permissible on both streams, and a combined dirt factor of 0.003 should be provided. Available for this service is a 21 ¼" ID exchanger having 156 3/4" OD, 12 BWG tubes 18'0" long and laid out on 1" triangular pitch. The bundle is arranged for 2 passes, and baffles are spaced 4" apart. 1) Calculate Flow rate of the cold fluid 2) Is the exchanger suitable? Consider the properties of the fluid at average temperatures.	35	CO4
Q 7	Acetone is to be recovered from an aqueous waste stream by continuous distillation. The feed will contain 15 per cent w/w acetone. Acetone of at least 99 w/w% purity is wanted, and the aqueous effluent must not contain more than 60 ppm acetone. The feed will be at 20^0C. Total number of ideal stages 18. Other details are given as: Feed rate = 15,000 kg/hr. $MW_{acetone}$= 57, MW_{water} =18. Slope of the Operating line at bottom & Top are 6.0 & 0.70 respectively. Reflux ratio = 1.20	35	CO5

Component	Temp (°C)	ρ_v (kg/m^3)	ρ_l (kg/m^3)	Surface Tension (N/m)
Steam	106	0.72	950	$55x10^{-3}$
Acetone (99 w/w %)	57	2.05	750	$23x10^{-3}$

Assume following parameters as per design standard for the design of the column

a) Velocity (% flooding) at maximum flow rate
b) Down comer area (as % of the total area)
c) Tray spacing.

1) Calculate the tower height. Assume 60% column efficiency.
2) Calculate the column Diameter