

Name: Manash Protim Mudoi

Enrolment No: 40001790



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: B.Tech Chemical R&P

Semester : 7th

Course Name : Chemical Process Equipment Design & Drawing

Time : 03 hrs.

Course Code : CHEG 401

Max. Marks: 100

Nos. of page(s) : 03

Instructions : Closed Book Exam. Data set Allowed

S. No	SECTIONS	Marks	CO
	SECTION A		
Q 1	Derive the equation for Flow No. N_Q for a turbine or propeller agitator. Assume all necessary parameters as required.	10	CO3
Q 2	Derive the equation for heat flow rate through a pipe wall.	10	CO4
	SECTION B		
Q 3	Draw a typical performance diagram for a sieve plate. Explain flooding, entrainment, coning & weeping.	10	CO5
Q 4	Estimate the number of plates, number of sections, dimensions (i.e. thickness, length & width) of each section of a storage tank made of CS for the data given below: Tank Mean Diameter = 20 m Tank Height = 12 m Sp. Gr. Of stored liquid = 1.0 Allowable stress = 142 MN/m ² Corrosion Allowance = 0.3 mm Assume Joint efficiency factor. Refer Table 1 & 2 for necessary data & information.	30	CO2
	SECTION-C		
Q 5	43,800 lb/hr of a 42 ^o API kerosene leaves the bottom of a distillation column at 390 ^o F and will be cooled to 200 ^o F by 149,000 lb/hr of 34 ^o API Mid-continent crude coming from storage at 100 ^o F and heated to 170 ^o F. A 10 psi pressure drop is permissible on both streams, and a combined dirt factor of 0.0003 should be provided. Available for this service is a 21 1/4" ID exchanger having 158 1" OD, 13 BWG tubes 16'0" long and laid out on 1 1/4" square pitch. The bundle is arranged for four passes, and baffles are spaced 5" apart. Calculate wall temperature using appropriate equation. Will the exchanger be suitable; i.e. what is the dirt factor? OR	40	CO4 OR CO5

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Acetone is to be recovered from an aqueous waste stream by continuous distillation. The feed will contain 10 per cent w/w acetone. Acetone of at least 98 per cent purity is wanted, and the aqueous effluent must not contain more than 50 ppm acetone. The feed will be at 20°C. Total number of ideal stages 16.

Other details are given as:

Feed rate = 13,000 kg/hr. $MW_{\text{acetone}} = 58$, $MW_{\text{water}} = 18$. Slope of the Operating line at bottom & Top are 5.0 & 0.57 respectively. Composition at the top is 94 mol. % (i.e. 98 w/w %). Bottom composition is essentially water. Reflux ratio = 1.35

Component	Temp (°C)	ρ_v (kg/m ³)	ρ_l (kg/m ³)	Surface Tension (N/m)
Steam	106	0.72	954	57×10^{-3}
Acetone (98 w/w %)	57	2.05	753	23×10^{-3}

Design the column for 85 % flooding at maximum flow rate. Assume down comer area as 12 % of the total area and tray spacing suitably.

1. Estimate pressure at bottom of the column. Assume 60% column efficiency. **5**
2. Calculate Column diameter at Top & bottom respectively. **30**
3. Calculate the Net area of a tray. **5**

Refer to figure 1 for necessary information and data.

Table 1: Steel Tables

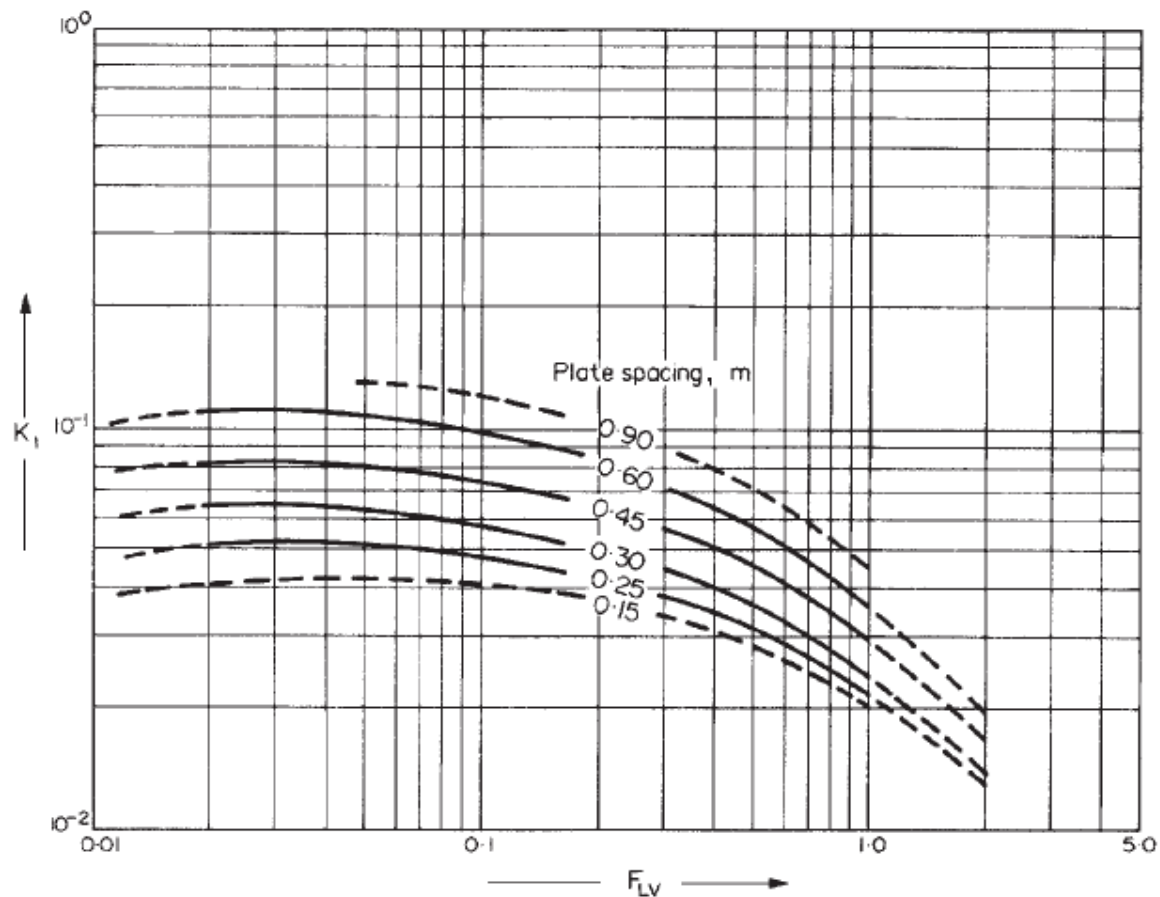
Standard Thickness (mm)	5, 5.5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80
Standard Width (mm)	160, 180, 200, 220, 250, 280, 320, 355, 400, 450, 500, 560, 630, 710, 800, 900, 1000, 1100, 1250, 1500, 1600, 1800, 2000, 2200, 2500
Length	6 m - 10 m easily available

Table 2: Minimum Nominal Thickness Required, Carbon Steel

Nominal Tank Diameter (metres)	Minimum Nominal Thickness (mm)
Smaller than 15	5.0
Over 15 upto and including 36	6.0
Over 36 upto and including 60	8.0
Over 60	10.0

The above thicknesses do not include corrosion allowance. Maximum plate thickness is 40 mm.

Figure 1: K_1 for Flooding Velocity, Sieve Plate



SET 2



H

Name of Examination (Please tick, symbol is given)	:	MID	NA	END	H	SUPPLE	NA
Name of the School (Please tick, symbol is given)	:	SOE	H	SOCS		SOP	
Program	:	B.Tech Chemical R&P					
Semester	:	7 th Semester					
Name of the Course	:	Chemical Process Equipment Design & Drawing					
Course Code	:	CHEG 401					
Name of Question Paper Setter	:	Manash Protim Mudoj					
Employee Code	:	40001790					
Mobile & Extension	:	9560213590					
Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE":							
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FOR OFFICE USE							
Date of Examination	:						
Time of Examination	:						
No. of Copies (for Print)	:						

Note: - Pl. start your question paper from next page

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	SECTION B		
Q 2	Draw a typical performance diagram for a sieve plate. Explain flooding, entrainment, coning & weeping.	10	CO5
Q 3	A 20 °API crude oil is cooled from 300 °F to 200 °F by heating cold 60 °API gasoline from 80 to 120 °F in a counter flow apparatus. At what fluid temperatures should U be evaluated.	10	CO4
Q 4	Estimate the number of plates, number of sections, dimensions (i.e. thickness, length & width) of each section of a storage tank made of CS for the data given below: Tank Mean Diameter = 20 m Tank Height = 12 m Sp. Gr. Of stored liquid = 1.0 Allowable stress = 142 MN/m ² Corrosion Allowance = 0.3 mm Assume Joint efficiency factor. Refer Table 1 & 2 for necessary data & information.	30	CO2
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