Department of Petrochemical Engineering
Subject: Petrochemical Engineering-III (BTPCC604) (Sample Question Bank)
Semester: VI

Unit I

1) Write critically on material of manufacture for pipes of pipestill heaters? Give reason for their choice?
2) State and briefly elaborate on different factors to be considered in designing radiant section of pipe still heater.
3) A petroleum stock at a rate of 1200 bbl/hr of sp. gravity 0.8524 is passed through a train of heat exchangers and is allowed to enter directly the radiant section of box type of heater at 220 ^{0}C.the heater is designed to burn 3500 kg /hr of refinery off gases as fuel. The net heating value of fuel is 47.46×10^3 kJ/kg. The radiant section contains 150 m^2 of projected area with one row of tubes (10.5 cm OD, 12 m long and spaced at 2 OD). Find out the outlet temperature of the stock.

   Data: $\alpha = 0.88$, Air –Fuel Ratio = 25

   Average specific heat of the stock = 2.268 kJ/kg. ^{0}C

4) With neat sketch of box type of pipestill heater , give the general description of pipe still heaters.
5) A petroleum stock at a rate of 1000 bbl/hr with API gravity 42^{0}API is passed through a train of heat exchangers and is allowed to enter directly the radiant section of box type of heater at 200 ^{0}C.The heater is designed to burn 3000 kg /hr of refinery off gases as fuel. The net heating value of fuel is 11300 kcal/kg. The radiant section contains 150 m^2 of projected area with one row of tubes (10.5 cm OD , 12 m long and spaced at 2 OD). Find out the outlet temperature of the stock.

   Data: $\alpha = 0.88$, Air –Fuel Ratio = 25

   Average specific heat of the stock = 2.66 kJ/kg. ^{0}C
6) With reference to pipe still heater, write a critical account on : Tubes or pipes
7) State and briefly elaborate on different factors to be considered in designing radiant section of pipe still heater
8) Briefly elaborate on role of refractory material in construction of pipe still heaters.
9) What are soot blowers? Explain their importance with reference to pipe still heaters.
10) Draw a neat labeled diagram of box type pipe still heater. Give its general description.
11) With reference to pipe still heaters, critically discuss on burners and soot blowers .
12) With reference to pipe still heaters , briefly elaborate on roles of following :

    i) Burners ii) Soot blowers and iii) Refractory

Unit II

1) Define bubble point pressure ,dew point pressure, bubble point temperature and dew point temperature .Derive an expression which allows calculation of fractional composition of component in vapor phase for flash distillation.
2) A multicomponent hydrocarbon mixture has the following composition on mole basis. i-butane- 0.20 , n-pentane- 0.25 and n-hexane –0.55.
   Calculate dew point temperature and bubble point temperature for this mixture at 100 psia.
   With appropriate example explain how understanding of concentration profile can be useful in design of distillation column.
3) A hydrocarbon mixture with following composition is to be flashed at 200 psia and 180 ^{0}F. calculate the composition of liquid and vapor under equilibrium condition.
   Ethane – 08 %,propane- 22%, n-butane 53 % and n pentane- 17 %
4) Define bubble point pressure ,dew point pressure, bubble point temperature and dew point temperature .Derive an expression which allows calculation of fractional composition of component in vapor phase for flash distillation.
5) A feed to a column has the composition given below and is at a pressure of 14 bar and temperature of 60 ^{0}C. Calculate the flow and composition of the liquid and vapor phases. Take equilibrium data from Depriesters chart.

Feed	Ethane	Propane	Iso-butane	n-Pentane
Kmol/hr	20	20	20	20

6) 6 Kmole of ethane, 3 Kmole of propane and 1 Kmole of n butane are mixed in a closed container and the temp. is adjusted to 75^0 F ? Calculate the bubble point and dew point pressure. Calculate composition of gas and liquid at equilibrium at temp. 75^0 F and 300 psia. You may assume that mixture behaves like an ideal solution.

7) A feed to a column has the composition given below and is at a pressure of 14 bar and temperature of 60 ^{0}C. Calculate the flow and composition of the liquid and vapor phases. Take equilibrium data from Depriesters chart.

Feed	Ethane	Propane	Iso-butane	n-Pentane
Kmol/hr	20	20	20	20

8) 6 Kmole of ethane, 3 Kmole of propane and 1 Kmole of n butane are mixed in a closed container and the temp. is adjusted to 75^0 F ? Calculate the bubble point and dew point pressure. Calculate composition of gas and liquid at equilibrium at temp. 75^0 F and 300 psia. You may assume that mixture behaves like an ideal solution.

Unit III

1) Write critically on : Pressure - An important design variable
2) Outline the method for calculation of number of stages for multicomponent distillation by Fenske–Underwood-Gilliland correlation.
3) Write an informative account on : Limits of operability of distillation column based reflux ratio.
4) A quaternary mixture at its dew point composed of component a,b,c and d is to be fractionated to produce the products indicated.The system is to be considered essentially ideal. Calculate the minimum reflux by Underwood method. The reflux is a bubble point liquid.

Component	x_f	α	x_D	x_B
a	0.047	4.2	0.1263	0.0000
b (LK)	0.072	1.57	0.1913	0.0010
C (HK)	0.600	1.0	0.6824	0.0350
d	0.281	0.8	0.0000	0.9649

5) Draw schematic representation of fractional distillation process. State the minimum essentials for the fractionation process.

6) Estimate the actual number of ideal stages needed in a Butane –Pentane splitter defined by composition given below. The column operates at a pressure of 8 bar with a reflux ratio of 2.0 .The feed is at its bubble point.

Component	Feed (F)	Distillate (D)	Bottoms(B)	A
Propane	5	5	--	5
iso Butane	15	15	--	2.6
n-Butane	25	24	1	2.0
iso-Pentane	20	01	19	1.0
n-Pentane	35	--	35	0.85
	100 kmol	45 kmol	55 kmol	

7) The feed to a butane pentane splitter of the following composition is to be fractionated into a distillate product containing 95% of the n-butane contained in the feed and the bottom product containing 95% of the iso-pentane in the feed. The reflux ratio for the fractionation will be 1.3 $(L_0/D)_{min}$ The column pressure is 100 psia and the feed and reflux are at bubble point condition. The condition estimated for the column are :

Distillate and reflux bubble point temperature at 100 psia = 145 ^{0}F

Bottoms bubble point temperature at 100 psia = 215 ^{0}F

The feed composition is

Component	x_f
$i - C_4$	0.06
$n - C_4$	0.17
$i - C_5$	0.32
$n - C_5$	0.45

Determine the number of stages and feed plate location for above separation by FUG shortcut method.

8) Draw schematic representation of fractional distillation process. State the minimum essentials for the fractionation process.

9) Estimate the actual number of ideal stages needed in a Butane –Pentane splitter defined by composition given below. The column operates at a pressure of 8 bar with a reflux ratio of 2.0 .The feed is at its bubble point.

Component	Feed (F)	Distillate (D)	Bottoms(B)	A
Propane	5	5	--	5
iso Butane	15	15	--	2.6
n-Butane	25	24	1	2.0
iso-Pentane	20	01	19	1.0
n-Pentane	35	--	35	0.85
	100 kmol	45 kmol	55 kmol	

10) The feed to a butane pentane splitter of the following composition is to be fractionated into a distillate product containing 95% of the n-butane contained in the feed and the bottom product containing 95% of the iso-pentane in the feed. The reflux ratio for the fractionation will be 1.3 $(L_0/D)_{min}$ The column pressure is 100 psia and the feed and reflux are at bubble point condition. The condition estimated for the column are :

Distillate and reflux bubble point temperature at 100 psia = 145 ^{0}F

Bottoms bubble point temperature at 100 psia = 215 ^{0}F

The feed composition is

Component	x_f
$i - C_4$	0.06
$n - C_4$	0.17
$i - C_5$	0.32
$n - C_5$	0.45

Determine the number of stages and feed plate location for above separation by FUG shortcut method.

Unit IV

1) A petroleum stock (API=61)has the following ASTM 1160 distillation data.

% Distilled	0	10	30	50	70	90	100
Temp. ^{0}F	150	270	380	470	598	720	789

Using Edmister method for inter-conversion, construct the phase diagram for above stock in sub-atmospheric region and from this diagram find EFV data at 400mm Hg.

2) Outline Van-winkle method for inter-conversion of ASTM data at 760mm Hg. to EFV data at 10mm Hg.

A petroleum stock (API = 65.0) to be processed for jet fuel has the following ASTM-D 158 760 mm Hg distillation range :

% Distilled	0	10	30	50	70	90	100
Temp. ^{0}F	90	155	265	335	417	518	597

For the above stock, construct the phase diagram in super-atmospheric region and then determine the EFV data at 100 psia . Use Edmister method for inter-conversion.

3) Give the schematic representation of different distillation curves resulting from the distillation of same crude by different methods used in petroleum industry. Comment on the nature of these curve.

4) Construct an EFV curve for the following 760 mm Hg ASTM distillation data by van Winkle method.

% Distilled	0	10	30	50	70	90	100
Temp. ^{0}C	104	158.8	221.1	282.22	325.5	383.33	407.5

5) For a particular stock atmospheric ASTM-D158 distillation data is as follows:

Volume % distilled	0	10	30	50	70	90	100
Temp ^{0}F	90	140	245	342	408	514	597

Obtain the atmospheric EFV data by using Van winkle method.

6) Outline Nelson method for inter-conversion of data. Why it is necessary to apply curvature correction?

7) It is desired to obtain the atmospheric EFV curve for a petroleum stock having the ASTM-D 86 distillation characteristics shown below. :

% Distilled	0	10	30	50	70	90	100
Temp. ^{0}F	225	322	445	542	635	740	815

Use Van winkle method for inter-conversion.

8) Outline method for construction of phase diagram in super-atmospheric region with ASTM D-86 data available at the beginning.

9) For a particular stock atmospheric ASTM-D158 distillation data is as follows:

Volume % distilled	0	10	30	50	70	90	100
Temp ^{0}F	90	140	245	342	408	514	597

Obtain the atmospheric EFV data by using Van winkle method.

10) It is desired to obtain the atmospheric EFV curve for a petroleum stock having the ASTM-D 86 distillation characteristics shown below. :

% Distilled	0	10	30	50	70	90	100
Temp. ^{0}F	225	322	445	542	635	740	815

Use Van winkle method for inter-conversion.

11) Outline method for construction of phase diagram in super-atmospheric region with ASTM D-86 data available at the beginning.

12) The following data results from ASTM D-1160 mm Hg distillation. Determine the EFV data at 200 mm Hg. Use Van winkle method.

% Distilled	0	10	30	50	70	90
Temp ^{0}F	230	300	355	412	475	535

13) Why interconversion of data is necessary in petroleum industry. Discuss with reference to the chniques used for determination of vaporization characteristics of petroleum and petroleum products.

14) Construct a TBP curve for the following 760 mm ASTM D-158 distillation data.

Vol. % distilled	0	10	30	50	70	90
Temp ^{0}F	225	322	445	542	635	740

Use Edmister Pollock method for interconversion

Unit V

1) With neat sketches ,explain the different types of distillation tower arrangement.
2) Write an informative account on overhead corrosion in distillation unit.
3) Why post treatment of different fractions is necessary? Briefly elaborate on physical or mechanical impurities.
4) Draw a neat flow diagram for Merox process.
5) Write informative account on Kerosene treatment.
6) Briefly elaborate on salient features of complex system distillation
7) With neat sketches , explain the necessity of different types of reflux in distillation.
8) Write a critical account on design of vacuum distillation unit with reference to petroleum refinery.

Unit VI

1) Discuss the different aspect with respect to the design of vacuum distillation unit.
2) Discuss the different aspect with respect to the design of vacuum distillation unit.