

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2023****Subject Code:3173617****Date:14-12-2023****Subject Name: Principles of Process Equipment Design****Time: 10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Define (a) Light key (b) Heavy key (c) Adjacent key (d) split key	03
	(b) List out the different types of reactors. Explain in brief about any one of them.	04
	(c) Find out the power required for a turbo blower for the following duty. Fluid= Atmospheric air, Capacity = 1000 Nm ³ /h, Discharge pressure = 2 atm a Ratio of specific heat Cp/Cv = 1.395. Also find the discharge temperature of air.	07
Q.2	(a) What do you mean by optimum Pipe size?	03
	(b) How to determine VLE data for distillation column design?	04
	(c) Explain the general design method for shell and tube heat exchanger with suitable equations.	07
OR		
	(c) Write down the process steps required for the design of Distillation column.	07
Q.3	(a) Write a short note on various parts of Shell and tube heat exchanger.	03
	(b) What are the different types of baffles used in shell and tube Heat exchanger? Explain it with suitable figures and also mention the functions of baffles.	04
	(c) It is proposed to pump 10,000 kg/h of saturated toluene at 114°C and 1.1 atm a from the reboiler of a distillation tower to a second distillation unit without cooling. If the friction loss in the reboiler and pump is 7 kPa and density of toluene is 866 kg/m ³ , how much liquid level in the reboiler is to be maintained to give a net suction head of 2.5 m? Calculate the power required to drive the pump if the pump is to elevate the toluene to 10 m to a second unit at atmospheric pressure. Assume friction loss in the discharge line to be 35 kPa. Pump efficiency is 62%.	07
OR		
Q.3	(a) Define: Reflux ratio. How to determine reflux ratio for binary distillation?	03
	(b) Describe Tinker's flow model in detail.	04
	(c) Determine the minimum reflux ratio for the saturated binary liquid mixture of benzene – toluene at standard atmospheric pressure based on the following data. Feed – 100 kmol/h, Mole fraction of benzene in feed – 0.4, Mole fraction of benzene in distillate – 0.99, Mole fraction of benzene in residue – 0.02, Average relative volatility – 2.25	07

- Q.4** (a) Explain in brief about NPSH. **03**
(b) How to allocate fluid in case of heat exchanger? Explain it in brief. **04**
(c) Explain the process design of pump with the relevant equations. **07**

OR

- Q.4** (a) Explain degree of completion of reaction. **03**
(b) Write in brief about power required in blower and in adiabatic compressor. **04**
(c) Discuss the advantages and disadvantages of vacuum distillation in detail. **07**

- Q.5** (a) Give the comparison between plug flow reactor and mixed flow reactor. **03**
(b) Explain the process design of bubble column reactor. **04**
(c) In the continuous process for the manufacturing of monochloroacetic acid (MCA) conversion of acetic acid is restricted to 50% to avoid the formation of dichloroacetic acid. Reaction is carried out in a bubble column reactor. Find out working volume of reactor. **07**

OR

- Q.5** (a) Mention the Advantages and disadvantages of batch reactor over continuous reactor. **03**
(b) Mention the industrial examples of bubble column reactor. **04**
(c) Write down the various factors affecting the performance of bubble column reactor. **07**
