

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE – SEMESTER- VII EXAMINATION-SUMMER 2023****Subject Code: 3170502****Date: 28/06/2023****Subject Name: 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.

		<b>MARKS</b>
<b>Q.1</b>	(a) Define Equivalent Length.	<b>03</b>
	(b) Justify the effects of larger diameter pipe operating cost and fixed cost	<b>04</b>
	(c) A centrifugal pump draws benzene from an overhead tank. Operating vacuum in the tank is 700 Torr. Vertical distance between free surface of liquid in tank and centerline of pump is 12 m. Maximum operating temperature is 50 °C. Vapour pressure of benzene at 50 °C is 280 Torr. Density of benzene at 50 °C is 870 kg/m <sup>3</sup> . Frictional loss in suction line of pump is 1 m of benzene column. Calculate the (NPSH) <sub>A</sub> of centrifugal pump	<b>07</b>
<b>Q.2</b>	(a) Explain functions of baffles in shell and tube heat exchanger	<b>03</b>
	(b) How baffle cut and baffle spacing affect shell side heat transfer coefficient	<b>04</b>
	(c) With neat diagram explain Tinker's flow model	<b>07</b>
	<b>OR</b>	
	(c) Discuss criteria of selection between Kettle-type Reboiler and Thermosyphon reboiler	<b>07</b>
<b>Q.3</b>	(a) Why expansion joint is provided in fixed tube sheet heat exchanger?	<b>03</b>
	(b) Discuss fluid allocation without phase change	<b>04</b>
	(c) Discuss in brief about heating and cooling medium	<b>07</b>
	<b>OR</b>	
<b>Q.3</b>	(c) Consider a case where condensation is done with subcooling by cooling water entering at 32°C. Heat duty of condensation is 1327 KW and heat duty for subcooling is 166 KW. Temperature difference of cooling medium is 8°C. Specific heat of cooling water 1 Kcal/Kg °C. Calculate the mass flow rates of cooling water required separately of condensation as well as subcooling and calculate intermediate temperature of cooling water utilized for subcooling assuming that entire flow rate of cooling water is utilized for subcooling first	<b>14</b>
<b>Q.4</b>	(a) Mention the application of Hegstebek and Geddes equation? Discuss the equation.	<b>03</b>

- (b) State the advantages of vacuum distillation. **04**
- (c) With suitable examples explain the concept of selection of operating pressure for distillation column. **07**
- OR**
- Q.4** (a) State the function of liquid distributors, packing support and hold down plate in packed tower type absorber? **03**
- (b) With neat sketch discuss any two types of random packing material used for packed tower type absorber. **04**
- (c) Write down selection criteria for packed tower and spray tower **07**
- Q.5** (a) Discuss in brief about Flat Heads **03**
- (b) Discuss about Internal Design pressure **04**
- (c) State the applications of various types of heads used for pressure vessel design **07**
- OR**
- Q.5** (a) Define Design stress, Corrosion Allowance, Welding Joint efficiency factor. **03**
- (b) What is Radiography? How it is being carried out? **04**
- (c) A nozzle having ID 400 mm is fabricated from S.S 316 plate. It is attached by welding to a vessel having ID 1500 mm. Internal design pressure = 10 Kgf/cm<sup>2</sup> , design temperature = 300 C. Maximum allowable stress at design temperature = 612.4Kg/cm<sup>2</sup> . Joint efficiency = 0.85 for both shell and nozzle, Corrosion allowance = 1.5 mm, Density of material = 7830 Kg/m<sup>3</sup> ,thickness of plate for shell fabrication is 18mm, use 18 mm 6.35 mm thick plate for nozzle fabrication, use 18 mm thick plate for reinforcement plate . Calculate weight of reinforcement pad. **07**

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