

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER- VII EXAMINATION – SUMMER 2026****Subject Code:3170502****Date:03-06-2026****Subject Name: Process Equipment Design****Time: 02:30 PM TO 05:00 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) Explain in brief about equivalent length of pipe and joints. **03**
- (b) Write a note on NPSH for centrifugal pump. **04**
- (c) Benzene at 37.8 °C is pumped through the system at a rate of 9.09 m³/hr. The tank is at atmospheric pressure. Pressure at the end of discharge line is 345 kPa g. The discharge head is 3.05 m and the suction lift is 1.22 m above the level of liquid in the tank. The friction loss in suction line is 3.45 kPa and that in the discharge line is 37.9 kPa. The mechanical efficiency of the pump is 0.6. The density of benzene is 865 kg/m³ and its vapor pressure at 37.8 °C is 26.2 kPa. Calculate (i) (NPSH)_A and (ii) Power required by the centrifugal pump. **07**
- Q.2**
- (a) Discuss the function of Tie rods, Baffles and spacers in shell and tube heat exchanger. **03**
- (b) Discuss Tinkers flow model **04**
- (c) Write the general steps for the design of shell and tube heat exchanger. **07**
- OR**
- (c) State the difference between kettle type reboiler and thermosyphon reboiler and describe its uses. **07**
- Q.3**
- (a) Define Weeping, Flooding velocity and entrainment in context with distillation column. **03**
- (b) Discuss selection of key components for multicomponent distillation. **04**
- (c) Discuss McCabe Thiele method for calculation of number of trays in distillation column. **07**
- OR**
- Q.3**
- (a) Discuss about the various packings used in a distillation column. **03**
- (b) State the advantages and disadvantages of vacuum distillation. **04**
- (c) A saturated liquid, consisting of phenol and cresol with some xylenols, is fractionated to give a top product of 95.3 mole % phenol. Metacresol is heavy key and phenol is light key component. Total condenser is used. The composition of the top product and of the phenol in the bottom is given. Complete the material balance over the still for a feed rate of 100 kmol/h and (ii) Calculate the minimum reflux ratio by Underwood's method. **07**

Component	α_{av}	Feed, mole %	Top product, mole %	Bottom product, mole %
Phenol	1.98	35	95.30	5.24
o-Cresol	1.59	15	4.55	?
m-Cresol	1.00	30	0.15	?
Xylenols	0.59	20	--	?

- Q.4** (a) State different types of weirs and downcomers of tray tower. **03**
- (b) Discuss the purpose of liquid distributor, re-distributors, packing supports and hold down plate in packed absorption column. **04**
- (c) Differentiate between tray column and packed column. **07**

OR

- Q.4** (a) What is channeling and discuss the ways to avoid channeling. **03**
- (b) Describe selection criteria for solvent in absorption column. **04**
- (c) Discuss process design steps of absorber. **07**

- Q.5** (a) Define Internal design pressure, Design stress and External design pressure. **03**
- (b) State different types of head with their selection criteria. **04**
- (c) Discuss different types of equipment and explain different static equipment. **07**

OR

- Q.5** (a) What is Radiography? Discuss types of radiography. **03**
- (b) Discuss different types of agitators. **04**
- (c) Describe design steps of vertical cylindrical pressure vessel and head subjected to internal pressure. **07**
