

GUJARAT TECHNOLOGICAL UNIVERSITY

BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 2160503

Date: 22/05/2026

Subject Name: Process Equipment Design -I

Time: 10:30 AM TO 01:30 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.**

Q.1 (a) Define NPSH and give its importance for pump design. 03

(b) Explain types and function of baffles in detail with sketch. 04

(c) Hexane 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 hexane is 659 kg/m³ and its vapor pressure at 37.8 °C is 33.71 kPa. Calculate (i) (NPSH)_A and (ii) Power required by the centrifugal pump. 07

Q.2 (a) Why expansion joint is provided in fixed tube sheet heat exchanger? 03

(b) Discuss in brief about fluid allocation for shell and tube heat exchanger. 04

(c) Discuss step wise design procedure for shell and tube heat exchanger without phase change. 07

OR

(c) In vertical thermosyphon reboiler recirculation ratio is fixed by trial and error method. Discuss in detail with diagram, how to find or fix the recirculation ratio in the following conditions: 07

1). $\Delta P_{av} > \Delta P_t$ 2). $\Delta P_{av} \ll \Delta P_t$ 3). $\Delta P_{av} \approx \Delta P_t$ 4). $\Delta P_{av} < \Delta P_t$

Q.3 (a) Describe functions of down comer & mention types of down comers. 03

(b) Discuss in brief the factors affecting selection of tray type. 04

(c) Discuss merits and demerits of vacuum distillation over atmospheric distillation with appropriate example. 07

OR

Q.3 (a) Explain in short –Jet flooding and Downcomer Flooding. 03

(b) Write a short note on determination of optimum reflux ratio. 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. 07
(i) 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.

Q.4	(a) Explain the function of liquid distributors, liquid re-distributor.	03
	(b) With sketch explain types of random and regular packings and their application.	04
	(c) Discuss the criteria for selection of various absorption equipments.	07
	OR	
Q.4	(a) State the merits and demerits of falling film absorber.	03
	(b) With sketch explain different types of packing support in tower absorber.	04
	(c) Discuss about process design of venturi scrubber.	07
Q.5	(a) How to decide optimum solvent amount based on number of theoretical stages.	03
	(b) Discuss selection of operating pressure for distillation column.	04
	(c) Explain in detail the process design of counter current multistage extractor.	07
	OR	
Q.5	(a) Compare extraction, with absorption and distillation.	03
	(b) List important industrial application of liquid-liquid extraction	04
	(c) Discuss various applications of liquid – liquid extraction in chemical industry	07
