Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3150506 Date:22-05-2025

Subject Name:Chemical Process Plant Design & Economics

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)**	Write in brief on continuous process v/s batch process	**03**
	(b)	It is desired to borrow ₹1000 to meet a financial obligation. Thos money can be borrowed from a bank at a monthly rate of 2 per cent (i) Calculate the total amount of principal plus compound interest due after 2 years if no intermediate payment is made. (ii) The nominal interest rate if the interest is compounded annually. (iii)The effective interest rate. if the interest is compounded annually.	**04**
	(c)	The original value of a reactor is ₹ 4,00,00,000 completely installed and ready for use. Determine the asset value of the equipment at the end of 5 years using straight line and declining balance method.	**07**
Q.2	**(a)**	Explain six-tenths factor rule	**03**
	(b)	What are the various stages of process development of a chemical plant?	**04**
	(c)	Explain cash flow for industrial operation by drawing tree diagram	**07**
		OR	
	(c)	List and discuss principles of plant layout.	**07**
Q.3	**(a)**	Write a short note on pipe fittings.	**03**
	(b)	Sketch an ideal plant layout. (Provide legend if required)	**04**
	(c)	A heat exchanger of area $25m^2$ had a cost of ₹50,00,000 in 2020. What is the estimated cost of $50m^2$ heat exchanger in 2023? Assume that cost index in 2020 was 600 and in 2023 is 800. Equipment cost vs. capacity factor is 0.58.	**07**
		OR	
Q.3	**(a)**	Write in brief the importance of utilities in chemical industries.	**03**
	(b)	Explain importance of pilot plant and scale up in chemical industry.	**04**
	(c)	Outline the list of preliminary specifications needed to be specified for equipment in specification sheet	**07**
Q.4	**(a)**	Write in brief on types of flow diagrams.	**03**
	(b)	State methods of estimating capital Investment. Discuss any one in detail.	**04**
	(c)	Enlist various methods of Profitability analysis. Explain any two methods in detail.	**07**

OR

Q.4 **(a)** A bond has a maturity value of ₹1000 after 5 years of interest rate of 12%. What is the value of the bond? **03**

(b) Distinguish between standard and special equipment. **04**

(c) Two pumps under consideration for installation at a plant have the following capital investments, salvage values and annual interest. **07**

	Capital investment ₹	Salvage value ₹	Interest rate per annum (%)
Pump A	40,000	3900	10
Pump B	50,000	20000	10

If annual cost of capital recovery is same for both the pumps. Then determine what should be the common life of the pumps. Maintenance and operational costs are negligible.

Q.5 **(a)** Explain Plant overhead cost **03**

(b) A distillation column has been installed at the cost of ₹10, 00,000 and is expected to have service life of 15 years with scrap value of ₹30,000. Calculate the capitalized cost of the distillation column based on annual interest rate of 5%. **04**

(c) The effect of variable x,y on total cost of particular operation $C_T = 2.33x + \frac{11900}{xy} + 1.86y + 100$. Determine value of x and y which will give the total least cost **07**

OR

Q.5 **(a)** Write a brief note on PERT techniques used for Inventory control **03**

(b) The annual production of a plant is ₹36.4 lakhs, while the sum of the fixed charges and general expenses are ₹26 lakhs. What is the breakeven point in unit of production per year., If total annual sales is ₹72.8 lakhs and product sales at ₹520 per unit **04**

(c) An R & D Project has certain activities to execute. First three of these activities include design (21), building prototype (5) and evaluating equipment (7). The first activity does not have any predecessor, but it is the predecessor of 2nd and 3rd activity. 4th activity is testing of prototype (2), in which building of prototype is the predecessor. Writing equipment report (5), method report (8), and final report (2) are considered as 5th, 6th and 7th activities. 3rd and 4th activities are the predecessor of 5th and 6th activity. 5th and 6th activities are the predecessors of 7th activity. Construct the network diagram and indicate the critical path. The numbers in the brackets indicate the time (in weeks) required for that particular activity. **07**

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