Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2170403 **Date: 19/11/2018**

Subject Name: Bioprocess Plant 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. **Notations used, have conventional meaning.**
5. **Assume suitable data wherever necessary.**

Q.1	**(a)**	What is Capacity and Economy of an evaporator?	**03**
	(b)	Define the term: stress, resilience, hardness, stiffness.	**04**
	(c)	Write a note on corrosion allowance & weld joint efficiency factor (j).	**07**
Q.2	**(a)**	Explain in brief: Design Temperature & Design Pressure	**03**
	(b)	Write a short note on: Process Flow Diagram.	**04**
	(c)	Discuss various types of feed arrangement used in multiple effect evaporators.	**07**
		OR	
	(c)	Explain the various types of flanges used in industry with neat sketch.	**07**
Q.3	**(a)**	Define the term relative volatility and its importance.	**03**
	(b)	Draw the neat sketch of various types of flanges used in industries.	**04**
	(c)	Starting with assumption & limitation, explain Mc-Cabe Thiele method.	**07**
		OR	
Q.3	**(a)**	Write the function of coil in reactor with its importance.	**03**
	(b)	Explain the types of jacket in brief.	**04**
	(c)	Explain different types of heads used in the industry with neat sketch.	**07**
Q.4	**(a)**	State the various types of agitators used in the reactor.	**03**
	(b)	Give classification of Nozzle stating the importance of each.	**04**
	(c)	Enlist various types of fabrication techniques used in industry. Explain any one in detail.	**07**
		OR	
Q.4	**(a)**	Discuss the term: Design stress & Poisson's ratio.	**03**
	(b)	Discuss the advantages and disadvantages of vacuum distillation in detail.	**04**
	(c)	Discuss the factors affecting the fluid allocation in Shell and Tube heat exchanger.	**07**
Q.5		Reactor (ID = 800 mm) with hemispherical head at the bottom. Inside working pressure is 75 kgf/cm^2 gauge & temperature is 70 °C. Reactor is covered with plain jacket such that 75% length of shell & bottom hemispherical head is covered with jacket. Cooling water is circulated inside the jacket by pumping with a centrifugal pump having a shut off discharge pressure 6 kgf/cm^2 (g). Hemispherical head is fabricated from SA-516 Grade 70. Maximum allowable stress at design temperature is 610 kgf/cm^2. Modulus of Elasticity of plate material (E) = 193 × 10^3 N/mm^2. Poisson's ratio (μ) = 0.3, ρ= 7.83 g/cm^3, Joint efficiency (j) = 0.85. Find thickness of the head and weight of the fabricated hemispherical head.	**14**

$$t_h' = \left(\frac{PD_i}{(4fJ - P)}\right) + CA \quad , \quad t_h' = 4.4r\sqrt{\frac{P}{2E}}\left(3(1-\mu^2)\right)^{\frac{1}{2}} + CA$$

OR

Q.5		A single effect evaporator is to be designed to concentrate 9000 kg/hr of a solution from 12% to 20% solids. Feed enters at 25 °C. Saturated steam at 110 °C (latent heat = 540 kcal/kg) is available. The condensate leaves at the condensing temperature. Saturation temperature of vapor to the condenser is 400C (λ = 580 kcal/kg). Specific heat of all solutions may be taken as 1 kcal/kg°C. Boiling point rise is 5°C. The evaporator has an overall heat transfer coefficient of 1900 kcal/hr.m^2.°C. Calculate: i) evaporator capacity, ii) evaporator economy, iii) The area of heating surface required. Use 1 kcal = 4186 J.	**14**