Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3170514 Date:07-01-2023

Subject Name:Mechanical Design of Process equipments

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.**

			Marks
Q.1	**(a)**	Describe in brief about design pressure & design temperature.	**03**
	(b)	Define (i) Toughness (ii) Fatigue (iii) Creep (iv) Poisson's ratio.	**04**
	(c)	Enlist various types of fabrication techniques used in industries for the designing of equipment. Explain any one in detail.	**07**
Q.2	**(a)**	Give full form of ANSI, TEMA and HTRI.	**03**
	(b)	Define Gasket, Gasket seating stress and Gasket factor.	**04**
	(c)	Discuss about different types of agitators and their selection criteria.	**07**
		OR	
	(c)	Explain in brief about classification on unfired vessel as per IS – 2825.	**07**
Q.3	**(a)**	Discuss stress vs strain curve.	**03**
	(b)	Describe various types of jackets and their selection criteria	**04**
	(c)	Discuss the design steps for the calculation of tube side heat transfer coefficient and pressure drop.	**07**
		OR	
Q.3	**(a)**	What is design stress and factor of safety? Explain in brief.	**03**
	(b)	Discuss about design of Torispherical head.	**04**
	(c)	A Reactor of 800 mm inside diameter is covered with hemispherical head at the bottom. Inside working pressure is 75 kgf/cm^2 (g) & working 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 6.0 kgf/cm^2(g). The hemispherical head is fabricated from SA-516 Grade 70. The 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 gm/cm^3, Joint efficiency (J) = 0.85. Take 3 mm corrosion allowance. Find: (i) thickness of the head (ii) volume of head and (iii) weight of the fabricated head	**07**
Q.4	**(a)**	Explain Normal and Emergency venting for storage vessel	**03**
	(b)	Discuss about design of saddle support.	**04**
	(c)	Determine the total number of shell plates and plate thickness of a storage tank to store Phosphoric acid of 85% w/w for phosphoric acid plant having production capacity of 762.83 MT. Density of pure H_3PO_4 is 1834 kg/m^3. Allowable stress of Monel is 170 MPa and D/H is 1.5. Corrosion allowance is negligible.	**07**

OR

Q.4	**(a)**	Discuss importance of sealing strips.	**03**
	(b)	Discuss external floating roof storage tank.	**04**
	(c)	Discuss the design steps for column supported conical roof.	**07**
Q.5	**(a)**	Discuss (i) Tie rods (ii) Spacers (iii) expansion joints.	**03**
	(b)	Explain tray support for vertical tall tower.	**04**
	(c)	Discuss the design steps for skirt support.	**07**

OR

Q.5 Determine the shell thickness for the entire tower height based on the following data. **14**

Shell I.D – 3500 mm, Working temperature – 180 °C, Working pressure – 2 N/mm^2(g), Design temperature – 200 °C, Top disengagement space – 200 mm, Base chamber height – 3200 mm, Specific gravity of material – 7.7, Permissible tensile stress – 95 N/mm^2, Insulation density – 7700 N/m^3, Corrosion allowance – 3 mm, Poisson's ratio (μ) = 0.3, Modulus of Elasticity of plate material (E) = 1.93×10^5 N/mm^2, Insulation thickness – 140 mm, Weight of top elliptical head – 2800 N, Weight of attachment (pipes, ladders & platform) – 1600 N/mm^2, Weight of column – 3×10^6 N, Weight of liquid and tray – 900 N/m^2, No. of trays – 60, Tray spacing – 0.7 m. Neglect the stress created by eccentric and seismic load. Determine the thickness of distillation column.