Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2024

Subject Code:3170514 Date:30-05-2024

Subject Name:Mechanical Design of Process equipments

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)**	Discuss the term: 1) poisons ratio ii) Modulus of elasticity iii) power Number.	**03**
	(b)	Enlist various types of fabrication techniques used in industries for the designing of equipment.	**04**
	(c)	Define (i) Hardness (ii) Ductility (iii) Yield Stress (iv) Resilience (v) Toughness (vi) Creep (vii) Fatigue.	**07**
Q.2	**(a)**	Define Gasket, Gasket seating stress and Gasket factor.	**03**
	(b)	Give the full name of ASTM, ANSI, ASME & HTRI.	**04**
	(c)	Discuss the flow pattern for axial flow and radial flow impellers also discuss importance of baffles.	**07**
		OR	
	(c)	Define the two most important stresses generated in a thin cylindrical shell and discuss the classification of the unfired pressure vessel as per IS – 2825.	**07**
Q.3	**(a)**	State the applications of various types of heads used for pressure vessel design.	**03**
	(b)	With neat sketch explain the uses of various types of jackets for reaction vessel.	**04**
	(c)	Examine the data given below to evaluate the requirement of compensation for the nozzle opening in a cylindrical shell. If compensation ring (Reinforcement pad) is required then find its dimensions and weight. Outside diameter of shell = 2 m Max. Working pressure within shell = 3.5 MN/m^2 Wall thickness for the shell = 0.05 m, Corrosion allowance = 3 mm Joint efficiency = 1 (for shell and nozzle), Length of nozzle = 100 mm MOC of shell, nozzle and reinforcement pad = IS 2002 Density of IS 2002 = 7800 kg/m^3, Allowable stress of IS 2002 =96 MN/m^2 O. D of nozzle (seamless) = 0.25 m, Nozzle wall thickness = 0.016 m	**07**
		OR	
Q.3	**(a)**	Discuss about requirement of stiffening rings in pressure vessels.	**03**
	(b)	Discuss about mechanical design of Eliptical head.	**04**
	(c)	Discuss the design steps for the calculation of overall heat transfer coefficient in shell and tube heat exchangers.	**07**
Q.4	**(a)**	State the function of dyke wall in the storage tank.	**03**
	(b)	Explain the types of tray supports.	**04**

(c) Design a storage tank of benzene having 200 tones capacity. Based on the given following data find out the number of plates required for shell and the thickness of shell plate. Storage tank can be classified as 'Class A Tank'. Tank diameter – 6 m, Tank height – 8.5 m, MOC is low carbon steel, density of benzene is 0.88 X 10^3 kg/m^3, Corrosion Allowance 2 mm, Joint efficiency = 0.85, Plate size 1 m X 1 m, Provision for welding is 2 mm. **07**

OR

Q.4 **(a)** Discuss external floating roof storage tank. **03**

(b) Briefly discuss about the wind girders for large open tanks. **04**

(c) Discuss the design steps for the conical roof with structural support. **07**

Q.5 **(a)** Discuss importance of sealing strips. **03**

(b) Explain tray support for vertical tall tower. **04**

(c) State and explain the different types of stresses induced in the shell of distillation column with their design equations. **07**

OR

Q.5 **(a)** Calculate the necessary shell thickness and stress analysis of a given fractionating column having following specifications. **14**
Shell I.D - 2 m, Design temperature – 150 ^oC, Design pressure – 6 kg/cm^2, Height of shell - 16 m, Top chamber Height – 1 m, Base chamber height – 2.75 m, Tray Spacing – 0.75 m, M.O.C – C.S, Density – 7700 kg/cm^3, Density of insulation – 800 kg/m^3, f – 980 kg/cm^2, J – 0.85, Corrosion Allowance – 2 mm, Thickness of Insulation – 60 mm, Head Elliptical a:b -2:1, Weight of each head – 2000 kg, Weight of attachments – 125 kg/cm^2, Wind Pressure – 120 kg/cm^2, E – 2 X 10^6 kg/cm^2, Yield point in compression – 2100 kg/cm^2, Factor of Safety – 3, Weight of Liquid Pressure Tray – 70 kg/cm^2.

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