GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2024

Subject Code:3170514   **Date:11-12-2024**
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)**	Define the terms (i)Ductility (ii) Elasticity (iii) Creep.	**03**
	(b)	Explain "Radiography test" for pressure vessels.	**04**
	(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.2	**(a)**	Discuss the term: Poisson's Ratio, Modulus of elasticity and Power number.	**03**
	(b)	What is design stress and factor of safety? Explain in brief.	**04**
	(c)	State and discuss the various types of flanges used in industries.	**07**
		OR	
	(c)	Discuss in detail about various types of static and rotary equipments used in industry.	**07**
Q.3	**(a)**	Discuss about mechanical design of Elliptical head.	**03**
	(b)	Discuss the various types of gaskets.	**04**
	(c)	Discuss the design steps for the calculation of tube side heat transfer coefficient and pressure drop.	**07**
		OR	
Q.3	**(a)**	With neat sketch show crown radius, knuckle radius and straight flange portion in Torispherical head.	**03**
	(b)	Discuss about mechanical design of Hemispherical head.	**04**
	(c)	Turbine agitators operating in a vessel of 1600 mm diameters is to be designed with the following data: Internal design pressure = 5 kgf/cm^2 Agitator diameter = 500 mm Max. agitator RPM = 200 Liquid viscosity = 400 cP Specific gravity of liquid = 1.2 Overhang length of shaft = 1300 mm No. of agitator blade = 6 Max. allowable Shear Stress in shaft (f$_s$)= 550 kgf/cm^2 Modulus of Elasticity 'E = 1.95 x 10^6 kgf/cm^2 Power number = 6 for N$_{Re}$ < 4500 = 4.5 for N$_{Re}$ > 4500 a) Calculate powers required & suggest suitable motor HP b) Calculate shaft diameter.	**07**
Q.4	**(a)**	Explain Normal and Emergency venting for storage vessel.	**03**
	(b)	Discuss external floating roof storage tank.	**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. **07**

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 =96 MN/m^2

O. D of nozzle (seamless) = 0.25 m,

Nozzle wall thickness = 0.016 m

OR

Q.4 **(a)** Discuss importance of sealing strips. **03**

(b) Discuss design steps of saddle support. **04**

(c) Explain the design steps for the conical roof with structural support, With neat sketch. **07**

Q.5 **(a)** Define Gasket seating stress and gasket factor. **03**

(b) Explain briefly: Determination of shell thicknesses at various heights for tray tower in case of internal pressure applied. **04**

(c) Discuss about heating systems and various types of jackets and coils used for the same. **07**

OR

Q.5 **(a)** Discuss (i) Tie rods (ii) Spacers (iii) expansion joints. **03**

(b) Explain different types of fabrication technique used for fabrication of pressure vessel. **04**

(c) Find the thickness of a straight cylindrical skirt support for distillation column based on following data. **07**

Diameter of column = 2500 mm

Height of distillation column = 40 m

Max. weight of vessel, its attachment & contents = 300000 kg

Diameter of skirt =2500 mm

Height of skirt = 5 m

Wind Pressure Up to 20 m Height = 100 kgf//m^2

Wind pressure at the top of column =128.5 kgf//m^2

Material used for skirt support = IS 800 structural steel

Max. allowable tensile stress = 1400 kgf//cm^2

Max. allowable compressive stress = 666 kgf//cm^2

Max. allowable bending stress = 1575 kgf//cm^2

Seismic coefficient =0.08

Joint Efficiency = 0.85

Minimum weight of empty vessel = 250000 kg

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