Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject code: 170502 **Date: 08/05/2015**

Subject Name: Process Equipment Design-II

Time: 02.30pm-05.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** List the basic mechanical properties which a material should possess and explain any two of them? **07**

(b) A vacuum distillation column is to operate under a top pressure of 50 mmHg(ab). Trays of distillation column are supported on periphery rings having 10 mm thickness and 75 mm width. The OD of column is 1 m and the tray spacing is 0.5 m. Check if the support rings will act as effective stiffening rings. The material of construction is carbon steel and the maximum operating temperature is 50^0C. If the shell thickness is 12 mm, check if this is sufficient. The modulus of elasticity at 50^0C is 200×10^3 N/mm^2. **07**

Q.2 **(a)** As a design engineer, which are the various pressure tests carried out for the design of pressure vessel, explain them in brief? **07**

(b) A Reactor having inside diameter of 1 meter with torispherical head having a crown radius of 1 meter and knuckle radius of 100 mm at the bottom. Inside working pressure is 10 kgf/cm^2 gauge and working temperature is 70°C. Reactor is covered with plain jacket such that 75% lengths of shell and bottom torispherical head are covered with jacket. Cooling water is circulated inside the jacket by using a centrifugal pump having a shut off discharge pressure 6 kgf/cm^2(g). The torispherical head is fabricated from SA 516 Grade 70 plate. **07**

1	Maximum allowable stress of this plate material at design temperature	600 kgf/cm^2
2	Modulus of Elasticity of plate material	19500 kgf/mm^2
3	Poisson's ratio	0.3
4	Density of plate material	7830 kg/m^3
5	Joint efficiency	0.85
6	Corrosion allowance	3 mm

Find: (1) Thickness of the head (2) Weight of this head

OR

Q.2 **(b)** Why are gaskets used? Write in brief on various types of gaskets? **07**

Q.3 **(a)** Give the function of baffles, tie rod, sealing strip, tube sheet, shell side partition and tube side partition in a heat exchanger. **07**

(b) Why is reinforcement pad provided? Outline its design method? **07**

OR

Q.3 Determine the shell thickness at different height of a storage tank for the given data: **14**

Storage capacity of the tank =611.11 m^3, Density ρ Fluid= 900 kg/m^3, joint efficiency J = 0.85, f = 1070 kg/cm^2, C.A. = 2, Type of welding joint = double welded butt joint, Available plate = 4 m × 1.5 m, Also calculate the total no. of plate required to fabricate the vessel. Nominal thickness of the standard plates are 5, 6, 8, 10, 12, 14, 16 in mm
(use H/D=1.0)

Q.4 It is desired to design a bracket support for a vertical cylindrical reaction vessel installed indoor. Following data are available. **14**

a. Diameter of the vessel = 1.5 m

b. Vessel height = 1.8 m

c. Clearance from vessel bottom to foundation = 1 m

d. Weight of vessel with content = 7500 kg

e. Number of brackets = 4

f. Height of bracket from the foundation = 2.0 m

g. Diameter of anchor bolt circle =1.65 m

h. Base plate dimension for bracket: 14 cm x15 cm

i. Distance between vessel wall and bracket end = 150 mm

j. Gusset plate are 125 mm apart from each other

k. Web plates dimensions for bracket height =0.7071

l. Base plate size = Extends 20 mm on either side of channel

m. Channel size = 150 × 75 (Area = 21 cm^2)

n. Modulus of section = 19 cm^3

o. Radius of gyration = 2.2 cm

p. Weight = 170 N/m

q. Eccentricity = 7.5 cm

Permissible stresses:

1. Tensile stress = 140 N/mm^2
2. Compressive stress = 128 N/mm^2
3. Bending stress = 157 N/mm^2
4. Permissible bearing pressure of concrete = 5.0 N/mm^2

Vessel is kept indoors; Calculate the base plate and gusset plate thickness and thickness of the column base plate.

OR

Q.4 **(a)** Outline the stepwise procedure for the design of Saddle support. **07**

(b) What are pressure relief devices? Give advantages and disadvantages of any two of them? **07**

Q.5 A distillation column is to be fabricated & installed, having following specifications: **14**

i. Shell O.D. at top = 2000 mm

ii. Shell length tangent line to tangent line = 22 m,

iii. External design pressure =1.003 kgf/cm^2

iv. Design temperature = 120 °C

v. Shell Material = SA-283 Grade C, Specific gravity = 7.865

vi. Type of shell plate joint = Double welded butt joint with 10% radiography (J = 0.85)

vii. Nominal thickness of the standard plates are 8, 10, 12, 14, 16 in mm

viii. Weight of top head= 315.55 kg

ix. Weight of stiffening ring = 41.51 kg

x. Tray spacing = 0.3 m

xi. Top disengaging space = 1.2 m

xii. Weight of one tray plus wt. of liquid over the same =120 kg/m^2

xiii. Wt. of attachments (pipes, ladders & platforms) = 150 kg/m

xiv. Wind pressure = 130 kgf/m^2

xv. Insulation thickness = 100 mm , Density of insulation = 500 kg/m^3

xvi. Maximum allowable stress of shell plate material at design temperature = 890 kgf/cm^2

xvii. Modulus of elasticity = 2×10^6 kgf/cm^2

xviii. Poisson's ration = 0.3

xix. Corrosion allowance

Neglect the stress created by eccentric load and seismic load.

OR

Q.5	**(a)**	Discuss about various safety devices used for pressure vessel.	**07**
	(b)	Discuss in detail the various types of jackets used for heating and Cooling.	**07**

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