Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 170502 **Date: 02/05/2017**

Subject Name: Process Equipment Design-II

Time: 02:30 PM to 05:30 PM **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)** Discuss the design of torispherical head for internal and external design pressure. **07**

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

Q.2 **(a)** Discuss the steps for the design of reinforcement pad for a nozzle. **07**

(b) Design the bracket support for vertical cylindrical vessel. The data is given as follows: **07**

Diameter = 3.0 m
Height = 4.0 m
Clearance of vessel from bottom of vessel to foundation = 1.0 m
Weight of vessel with its content = 60,000 N
Wind pressure (Pw) = 1285 N/m^2
Diameter of anchor bolt circle bolt = 3.15 m
No. of bracket = 6
Base plate of bracket = 150 mm × 200 mm

Permissible stress for structural steel

Tensile σ_t = 140 N/mm^2,
Bending σ_{bm} = 157.5 N/mm^2,
Compressive σ_{comp} = 123.3 N/mm^2,
Permissible bearing pressure for concrete = 3.5 N/mm^2

Column Support for bracket

Size = 150 x 75
Area of Cross section = 20.88 cm^2
Modulus of Section = 19.4 cm^3
Radius of gyration = 2.4 cm
Wight = 164 N/m
Height from foundation = 2.25 m

OR

(b) Define the following. (i) Elasticity (ii) Brittle fracture (iii) Yield stress (iv) Resilience (v) Toughness (vi) Creep (vii) Welding joint efficiency factor. **07**

Q.3 A flat blade turbine agitator with six blades is installed centrally in vertical tank. The tank is 1.83 m in diameter; turbine is 0.61 m in diameter and is positioned at 0.61 m from the bottom of tank based on the following data. **14**

Height of liquid in tank = 1.83 m
Viscosity of liquid = 15 cP
Density of liquid = 1500 kg/m^3
Speed of agitator = 90 rpm
Np=6
Length of agitator shaft between bearing & agitator = 2.1 m
Width of blade = 120 mm
Nos. of baffles at tank wall = 4
Shaft and agitator blade material = IS 2062 Grade ST 42 – W
Ultimate tensile stress = 4200 kgf/cm^2
Yield stress = 2300 kgf/cm^2
Maximum allowable shear stress in shaft = 550 kgf/cm^2
Modulus of elasticity = 19.5 × 105 kgf/cm^2
Factor of Safety = 2
Calculate (i) power required for agitation (ii) shaft diameter and (iii) thickness of agitator blade.

$$\tau_C = \frac{hp\ of\ motor \times 60}{2\pi N}\ ,\ \delta = \frac{Wl^3}{3EI},\ N_P = \frac{P\,g_c}{\rho\, n^3 D_a}$$

OR

Q.3 Discuss the various steps used for design of column supported conical roof. **14**

Q.4 **(a)** Define Gasket seating stress and gasket factor. State the different types of gaskets and explain any three of them. **07**

(b) Explain the function of the following parts for the shell and tube heat exchanger. (i) Baffles (ii) Tie rods (iiii) Spacers (iv) Expansion joint (v) Tube side pass partition (vi) Tube sheet (vii) Support. **07**

OR

Q.4 Design a skirt support for distillation column based on following data. **14**

Diameter of column = 2500 mm
Height of distillation column = 40 m
Maximum weight of vessel, its attachments and contents = 300,000 kg
Type of skirt support = straight cylindrical
Diameter of skirt = 2500 mm
Height of skirt = 5 m
Wind pressure at the bottom of vessel = 100 kg/cm^2
Wind pressure at the top of vessel = 128.5 kg/cm^2
Material used for skirt support = IS 800, Structural Steel
Allowable tensile stress of material = 1400 kg/cm^2
Allowable compressive stress of material = 666 kg/cm^2
Allowable bending stress of material = 1575 kg/cm^2
Allowable compressive stress of concrete = 35 kg/cm^2
Seismic coefficient = 0.08
Joint efficiency = 0.85
Minimum weight of empty vessel = 250,000 kg
Allowable tensile stress of bolt material = 1020.7 kg/cm^2
Spacing between stiffeners = 203.2 mm

Q.5 The shell & tube heat exchanger has the following data: **14**

Shell inside diameter : 596.9 mm
Tube o.d. = 19.05 mm
Thickness of tube = 1.65 mm
Internal operating pressure of shell side = 3.0 kgf/cm^2
Internal operating pressure of tube side = 6.0 kgf/cm^2
Allowable stress for shell and tube material = 1054 kgf/cm^2
Material of shell : SA 312 TP 304 (seamless pipe)
Material of tube : SS 304
Density of SS 304 = 8000 kg/m^3
Mean diameter of gasket = 673 mm
No. of pass on tube side = 2
Depth of pass partition plate = 5 mm

Calculate:
thickness of shell
thickness of tube
thickness of head
blank diameter and weight of head
thickness of tube sheet.

Use only internal design pressure.
Neglect the thickness calculation by external design pressure.

OR

Q.5 (a) With a neat sketch discuss various types of Flange facings used in reaction vessel. **07**

(b) Write a note on Pressure relieving devices. **07**

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