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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2170502 **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)** Explain the function of the following parts for the shell and tube heat exchanger. (i) Baffles (ii) Tie rods (iii) Spacers (iv) Expansion joint (v) Tube side pass partition (vi) Tube sheet (vii) Support. **07**

(b) Define (i) Elasticity (ii) Toughness (iii) Fatigue (iv) Creep (v) Poisson's ratio (vi) Moment of inertia (vii) Welding joint efficiency factor. **07**

Q.2 **(a)** Explain the various types of flanges used in industry. **07**

(b) Turbine agitators operating in a vessel of 1600 mm diameters is to be designed with the following data : **07**

Internal design pressure = 5 kgf/cm^2
Agitator diameter = 500 mm
Max. agitator RPM = 200
Liquid in vessel m = 600 cP
Specific gravity = 1.2
Over hang length of shaft = 1200 mm
No. of agitator blade = 6
Elastic limit = 250 N/mm^2
Permissible shear stress in shaft = 55 N/mm^2
Modulus of Elasticity 'E = 19.5 x 10^4
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.

OR

(b) Write a short note on safety valves. **07**

Q.3 **(a)** Explain design procedure for saddle support. **07**

(b) Discuss about different types of agitators and their selection criteria. **07**

OR

Q.3 **(a)** A process vessel is to be designed for the maximum operating pressure of 500 kN/m^2. The vessel has the nominal diameter of 1.2 m and tangent to tangent length of 2.4 m. The vessel is made of IS : 2002 – 1962 Grade 2 B quality steel having allowable design stress value of 118 MN/m^2 at working temperature. The corrosion allowance is suggested to be 2 mm for the life span expected for the vessel. The vessel is to be fabricated according to class 2 of Indian standard specifications which stipulate the weld joint efficiency of 0.85. **07**

a) What will be the standard plate thickness to fabricate this vessel?
b) If a spherical vessel having the same diameter and thickness is fabricated the same quality steel, what maximum internal pressure the sphere will withstand safely?

(b) Discuss the design of tray support. **07**

Q.4 **(a)** Examine the data given below to evaluate the requirement of compensation for the nozzle opening in a cylindrical shell. Find out ring pad dimensions. **07**

1) Outside diameter of the shell – 2 m
2) Maximum working pressure – 3.5 Mn/m^2
3) Wall thickness for the shell – 0.05 m
4) Corrosion Allowance – 3×10^{-3} m
5) Weld joint efficiency factor (Class I) – 1
6) Allowable stress (IS: 2002 – 1962 – 2A) – 96 Mn/m^2
7) Outside diameter of nozzle (seamless)- 0.25 m
8) Nozzle – wall thickness - 0.016 m
9) Length of nozzle above surface – 0.1 m

(b) Explain in brief about classification on unfired vessel as per IS – 2825. **07**

OR

Q.4 **(a)** Explain in detail basic properties of material. **07**

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

Q.5 **(a)** Discuss in detail the various types of jackets used for heating and Cooling. **07**

(b) Discuss the design steps for column supported conical roof. **07**

OR

Q.5 **(a)** Discuss about the various types of fabrication technique used for fabrication of pressure vessel. **07**

(b) A fractionating tower is 4 m in outside diameter by 6 m in length from tangent line to closures. The tower contains removable trays on a 1m tray spacing and is to operate under vacuum at 400 ^{0}C. The material of construction is IS: 2002 – 1962 Gr. I plain carbon steel. Determine the required thickness of the shell without stiffeners and then with stiffeners located at the tray positions. **07**

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