

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII EXAMINATION – SUMMER 2016****Subject Code:170502****Date:07/05/2016****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** Design a bracket support for reaction vessel based on following data. Brackets are welded with outside surface of the reactor shell. **14**
- OD of reactor shell = 1052.7 mm, Thickness of the shell = 6.35 mm, Height of the vessel = 2.1524 m, Clearance from vessel bottom to foundation = 0.75 m, Weight of vessel with contents = 3918.9 kg, Wind pressure = 100 kgf/m², No of brackets = 4, Diameter of bolt circle = 1202.7 mm, Size of base plate for bracket = 150 mm x 150 mm, Height of the C channel from foundation = 2.0264 m, Size of C channel = 150 mm x 75 mm, Area of cross section = 20.88 cm², Modulus of section = 19.4 cm³, Radius of gyration = 2.21 cm, MOC for support = IS 800, Max. allowable tensile stress = 1400 kgf/cm², Max. allowable compressive stress = 1233 kgf/cm², Max. allowable bending stress = 1575 kgf/cm²
- Q.2 (a)** Classify the chemical equipment from mechanical design point of view. **07**
- (b)** Define (i) Elasticity (ii) Fatigue (iii) Creep (iv) Resilience (v) Toughness (vi) Longitudinal stress (vii) circumferential stress. **07**
- OR**
- (b)** A Reactor (ID = 1000 mm) with hemispherical head at the bottom. Inside working pressure is 75 kgf/cm² (g) & working temperature is 70 °C. Reactor is covered with plain jacket such that 75% length of shell & bottom hemispherical head is covered with jacket. Cooling water is circulated inside the jacket by pumping with a centrifugal pump having a shut off discharge pressure 6.0 kgf/cm²(g). The hemispherical head is fabricated from SA-516 Grade 70. The maximum allowable stress at design temperature is 610 kgf/cm². Modulus of Elasticity of plate material (E) = 193 × 10³ N/mm². Poisson's ratio (μ) = 0.3, ρ = 7.83 g/cm³. Joint efficiency (J) = 0.85. Take 3 mm corrosion allowance. Find: (i) Thickness of the head and (ii) weight of the fabricated head. **07**
- Q.3** Turbine agitators operating in a vessel of 1.6 m diameter is to be designed with the following data. **14**
- Internal design pressure – 5 kgf/cm², Agitator diameter – 500 mm, Maximum agitator rpm – 200, Viscosity of liquid – 600 cp, Specific gravity of liquid – 1.2, Over hang length of shaft – 1200 mm, No. of agitator blade – 6, Elastic limit – 250 N/mm², Permissible shear stress in shaft – 55 N/mm², Modulus of elasticity – 19.5 × 10⁵ kgf/cm². Calculate (i) power required and (ii) shaft diameter and (iii) critical speed.
- Power number – 8 for NRe < 1500, 6 for 1500 < NRe < 3000, 4.5 for 3000 < NRe < 4500, 3 for 4500 < NRe < 6000 and 2 for NRe > 6000.
- OR**
- Q.3 (a)** Discuss in detail the various types of jackets for heating and Cooling. **07**
- (b)** Define gasket seating stress and discuss the various types of gaskets used in industries. **07**

- Q.4 (a)** Explain Normal and Emergency venting for storage vessel. **07**
(b) Briefly explain the steps of the general design method for shell and tube heat exchanger. **07**
- OR
- Q.4** With neat sketch explain the design steps for the conical roof with structural support. **14**
- Q.5 (a)** Write a short note on Tray supports used for distillation column. **07**
(b) With neat diagram write a note on (i) Safety valve (ii) Relief valve **07**
- OR
- Q.5** Determine the shell thickness and stress analysis for the fractionating column having following specifications. **14**
 Shell I.D - 3500 mm, Working temperature – 180 °C, Working pressure – 2 N/mm² (gauge), Design temperature = 200 °C, Top disengagement space – 200 mm, Base chamber height – 3200 mm, Sp. Gravity of material – 7.7, Permissible tensile stress – 95 N/mm², Insulation density – 7700 N/m³, Corrosion allowance = 3 mm, Poisson ratio = 0.32, Modulus of elasticity E = 1.93×10^5 N/mm² Insulation thickness – 140 mm, Head type – Elliptical, Weight of head – 2800 N, Weight of pipe, ladders, platform etc. – 1600 N/m², Wind pressure - 1600 N/m², Weight of liquid and tray – 900 N/m², Seismic load and eccentricity are negligible, No. of trays – 60, Tray spacing – 0.7 m.
