Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2014

Subject Code: 170502 Date: 03-06-2014

Subject Name: Process Equipment Design-II

Time: 02:30 pm - 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)** Briefly discuss about determination of design pressure and design temperature. **04**

(b) Answer the following questions. **10**

i. Give full form of TEMA and HTRI?

ii. Define weld joint efficiency factor. Explain radiography test.

iii. How many brackets are required, if vessel diameter > 5 m? Short vertical cylindrical vessels are generally supported by bracket support. True or False?

iv. With neat sketch show crown radius, knuckle radius and straight flange portion in torispherical head.

v. If Reynolds number > 300, baffles are required in agitated vessel? True or False? Why?

Q.2 **(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 2B 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**

i. What is the standard plate thickness to fabricate this vessel?

ii. If a spherical vessel having the same diameter and thickness is fabricated with the same quality steel, what maximum internal pressure the sphere will withstand safely?

(b) Explain in detail basic properties of material. **07**

OR

(b) Describe different methods for fabrication of equipment. **07**

Q.3 **(a)** Prepare a list of different types of standard flanges. Explain with neat sketch any two standard flanges in detail. **07**

(b) Write a short note on mechanical design of shell and tube heat exchanger. **07**

OR

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

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

Q.4 **(a)** Calculate the base plate thickness and gusset plate thickness for bracket support. **07**

Data Given:
Weight of vessel with contents = 7 tons, Diameter of vessel = 1.5 m
Height of Vessel = 2 m, Vessel clearance from foundation = 1 m
Height of bracket from foundation = 2 m, Number of brackets = 4
Bolt circle diameter=1.6 m, Permissible bending stress for the material=160 N/mm^2
Base plate size = 15 cm X 15 cm, Space between gusset = 12 cm
Height of gusset vessel = 120 cm
Vessel is kept inside the room.

(b) Write a short note on tray support. **07**

OR

Q.4 **(a)** A fixed conical roof storage tank is fabricated from structural carbon steel plate (IS-2062). Based on given following data find out the thickness of conical roof plate. Storage tank can be classified as 'Class A tank'. **07**

Data Given:
Tank diameter = 7 m, Tank height = 5 m
Slope of conical roof = '1 in 6', Superimposed live load on roof = 125 kgf/m^2.
Modulus of Elasticity = 2 x 10^6 kgf/cm^2, Density of plate material = 7800 kg/m^3.
Poisson's rtion = 0.3, Thickness of topmost shell course = 10 mm

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

Q.5 A turbine agitator is used in a process vessel of 1.5 m diameter, calculate the horse power and shaft diameter. **14**

Data given:
Tank diameter = 1.5 m, Impeller diameter = 0.5 m
Impeller speed = 120 rpm, Density of liquid = 1250 kg/m^3.
Viscosity of liquid = 250 cp
Overhang of the shaft between the bearing and the agitator = 2 m
Elastic limit in tension = 2500 kg/cm^2, Modulus of elasticity = 2 x 10^6 kgf/cm^2.
f = 50 kgf/cm^2, N_p = 6 for $N_{Re} < 4500$, N_p = 5 for $N_{Re} > 4500$

OR

Q.5 From the stress analysis, calculate the shell thickness of a tall fractionating column. **14**

Data given:
Design pressure = 5 kgf/cm^2, Design temperature = 200 °C.
Shell ID = 2 m, Tray spacing = 0.75 m
Total height of vessel = 18 m, Top chamber height = 1 m
Bottom chamber height = 1.5 m, Tray spacing = 0.75 m
Material of construction = carbon steel, M. O. C. = C. S., Sp. Gr. = 7.7
f = 1000 kgf/cm^2, t_{ins} = 50 mm, Density = 750 kgf/cm^2.
Weight of attachment = 100 kg/m, Weight of liquid and tray = 80 kg/m^2.
Wind pressure = 150 kg/m^2, Corrossion allowance = 2 mm
Head: Elliptical
Weight of top head = 4 tons, Weight of bottom head = 4 tons
Poisons ratio = 0.3, Young's modulus = 1.95 x 10^6 kgf/cm^2.
Tower is located at a non-seismic zone and eccentric loads are negligible.

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