Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – WINTER 2013

Subject Code: 170403 Date: 07/12/2013

Subject Name: Bioprocess Plant design

Time: 10:30 TO 01:00 Total Marks: 70

Instructions:

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

Q.1 The chemical company has a polymerization cylindrical vessel for the following specifications. Find out the thickness of shell & thickness of jackets. **14**

For following three options:-

(1) Reactor with plain jacket.

(2) Reactor with half coil jacket.

(3) Reactor with channel jacket.

DATA:-

$D_i s$ = 2100 mm, $D_i j$ = 2198 mm

Tangent to tangent length of shell = 2500 mm

Diameter of half coil jacket = 100 mm

Internal pressure in shell = 0.55 N/mm^2

Internal pressure in jacket = 0.35 N/mm^2

Allowable stress of M-O-C = 98 N/mm^2

E =190 * 10^3 N/mm^2

Factor of safety = 4

Poisson's ratio = 0.3

corrosion allowance =2 mm

Q.2 **(a)** Give an account of the different common type and tubing materials available and their specifications. **07**

(b) Define the following:- **07**

Stress, Strain, Ductility, Malleability, Brittleness, Fatigue, Creep.

OR

(b) Answer the following in short. **07**

[1] Heaviness of pipe increase as schedule number decrease. Is it true?

[2] Nominal size represents outside diameter. Is it true? Justify.

[3] Birmingham wire Gauge is used for tubing. Is it true or false?

[4] What is the help from tapered shape of plug cock?

[5] Which valve limits to a pressure of 50 lb/in^2?

[6] Write the use of check valves.

[7] Can piston be useful for heads upto 200ft?

Q.3 **(a)** Compare single and multiple effect evaporation. **07**

(b) Write a notes on heads and closures. **07**

OR

Q.3 **(a)** Explain Boiling point elevation and durhing's rule. **07**

(b) A single effect evaporater operates at 12 kN/m^2. What will be the heating surface necessary to concentrate 1.25 kg/sec of 10% caustic soda to 40%, assuming a value of U= 1.25 $kW/m^2\ ^0K$ using steam of 390 ^0K? **07**

Boiling point rise at solution=30 ^0K

Feed temperature=291 ^0K

Cp of feed=4 kJ/kg ^0K

Cp of product=3.26 kJ/kg ^0K

Specific gravity of boiling liquid=1.39

Q.4 **(a)** Different methods of feeding in multiple effect evaporation. **07**

(b) A vessel having an inside diameter of 5m is operated under an internal pressure of 3 kgf/cm ² gm. Conical head is to be used as bottom head with an apex angel of 60° .Material has an allowable stress of 935 kgf/cm² of designed temperature and joint efficiency of 80%. Vessel can be subjected to vacuum. Take 2mm corrosion allowance. Design the conical head without using stiffening rings. **07**

DATA:

a) Poisson ´s ratio, $\mu = 0.3$
b) Density of material, $\rho = 7.83$gm/cc
c) Modulus of elasticity ,$E = 2*10^6$kgf/cm².

OR

Q.4 **(a)** Data for pressure vessel are given below: **07**

Capacity:10000L (cylindrical portion only)
Operating pressure = 10kgf/cm² .J = 0.85
Torispherical heads are provided at both sides .
For torispherical head, Rc = 10% excess of I.D.
R_1 = 10% of Rc
Taking L/D = 5 , calculate and suggest the plate thickness of shell .
Also calculate the thickness of torispherical head and total weight of shell with heads .

(b) Discuss *pitting* and *erosion* corrosion. **07**

Q.5 **(a)** Describe stepwise *McCabe - Thiele* method for determination of Numbers of theoretical stages in a distillation column. **07**

(b) Write down the classification of reciprocating pump with a brief about the designing aspects. **07**

OR

Q.5 **(a)** What is NPSH? Give the suitable equations for $(NPSH)_{available}$ and $(NPSH)_R$. **07**

(b) Enlist major pipeline stressing. **07**

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