

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:-

$$D_i = 2100 \text{ mm}, D_j = 2198 \text{ mm}$$

$$\text{Tangent to tangent length of shell} = 2500 \text{ mm}$$

$$\text{Diameter of half coil jacket} = 100 \text{ mm}$$

$$\text{Internal pressure in shell} = 0.55 \text{ N/mm}^2$$

$$\text{Internal pressure in jacket} = 0.35 \text{ N/mm}^2$$

$$\text{Allowable stress of M-O-C} = 98 \text{ N/mm}^2$$

$$E = 190 \times 10^3 \text{ N/mm}^2$$

$$\text{Factor of safety} = 4$$

$$\text{Poisson's ratio} = 0.3$$

$$\text{corrosion allowance} = 2 \text{ mm}$$

- 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/in²?

[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 Durand's rule. **07**

- (b)** A single effect evaporator operates at 12 kN/m². What will be the heating surface necessary to concentrate 1.25 kg/sec of 10% caustic soda to 40%, assuming a value of $U = 1.25 \text{ kW/m}^2 \text{ } ^\circ\text{K}$ using steam of 390 ⁰K? **07**

$$\text{Boiling point rise at solution} = 30 \text{ } ^\circ\text{K}$$

$$\text{Feed temperature} = 291 \text{ } ^\circ\text{K}$$

$$C_p \text{ of feed} = 4 \text{ kJ/kg } ^\circ\text{K}$$

$$C_p \text{ of product} = 3.26 \text{ kJ/kg } ^\circ\text{K}$$

$$\text{Specific gravity of boiling liquid} = 1.39$$

- 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/cm² gm. Conical head is to be used as bottom head with an apex angle 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, $\rho = 7.83 \text{ gm/cc}$
- c) Modulus of elasticity, $E = 2 \times 10^6 \text{ kgf/cm}^2$.

OR

- Q.4 (a)** Data for pressure vessel are given below: **07**
- Capacity: 10000L (cylindrical portion only)
- Operating pressure = 10 kgf/cm² .J = 0.85
- Torispherical heads are provided at both sides .
- For torispherical head, $R_c = 10\%$ excess of I.D.
- $R_1 = 10\%$ of R_c
- 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 $(NPSH)_{\text{available}}$ and $(NPSH)_R$. **07**
- (b)** Enlist major pipeline stressing. **07**
