Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: 170403 **Date: 04-12-2014**

Subject Name: Bioprocess Plant Design

Time: 10:30 am - 01:00 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)**	Narrate the selection criteria of operating pressure and vapour – liquid equilibrium.	**07**
	(b)	What are the different types of nozzles?	**07**
Q.2	**(a)**	Explain: Boiling point elevation and Durhing's rule.	**07**
	(b)	Discuss vacuum distillation with advantages and disadvantages from design point of view only.	**07**
		OR	
	(b)	Write the advantages and disadvantages of forward feed and backward feed effects of evaporation.	**07**
Q.3	**(a)**	A Reactor (ID = 980 mm) with hemispherical heat at the bottom. Inside working pressure is 100 kgf/cm^2 gauge and working temperature is 70°C. Reactor is covered with plain jacket such that 75% lengths of shell and bottom hemispherical head are covered with jacket. Cooling water is circulated inside the jacket by pumping with a centrifugal pump having a shut off discharge pressure 6 kgf/cm^2 (g). The hemispherical head is fabricated from SA 516 Grade 70 plate. Maximum allowable stress of this plate material at design temperature is 610 kgf/cm^2. Modulus of Elasticity of plate material = 193 x 10^3 N/mm^2, Poisson's ratio = 0.3, Density of plate material = 7830 kg/m^3, Joint efficiency = 0.85, Corrosion allowance = 3 mm. Find: (1) Thickness of the head (2) Weight of this head.	**10**
	(b)	Explain the terms: (1) Design stress & factor of safety (2) Weld joint efficiency factor.	**04**
		OR	
Q.3	**(a)**	Draw technical sketches of : [1] torispherical head [2] conical head and write its importance.	**07**
	(b)	Discuss the classification and types of the pumps for pharmaceuticals and biotech industries with uses of each.	**07**
Q.4		Design a reactor for the following three options: Reactor with plain jacket, Reactor with channel jacket and Reactor with half coil jacket. Data: Inside diameter of shell = 1050 mm, Inside diameter of jacket = 1110 mm , Shell length = 12 cm, Diameter of half coil = 6 cm, Width of channel jacket = 5.8 cm, Internal design pressure for shell = 4 kgf/cm^2, Internal design pressure for jacket = 2kg/cm^2,MOC for both shell and jacket is same. Max. allowable stress for MOC = 980 kgf/cm^2,Modulus of elasticity, E, for MOC = 19x10^5 kgf/cm^2, Poisson's ratio, μ = 0.3, J = 0.85,Corrosion allowance = 2 mm.	**14**

OR

Q.4 **(a)** Data for pressure vessel are given below: **10**

Capacity:10000 L (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% 0f R_s

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) Write a note on: Cavitation of pumps **04**

Q.5 **(a)** Discuss the factors on which $(NPSH)_R$ depends. **07**

(b) Clarify on terms: velocity head, total suction head and total discharge head. **07**

OR

Q.5 **(a)** Discuss the piping designs and comment on stresses on pipelines. **07**

(b) Write a note on cost estimation features relating economy of bioreactors and bioprocesses. **07**

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