

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 head at the bottom. Inside working pressure is 100 kgf/cm² 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/cm² (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/cm². Modulus of Elasticity of plate material = 193×10^3 N/mm², Poisson's ratio = 0.3, Density of plate material = 7830 kg/m³, Joint efficiency = 0.85, Corrosion allowance = 3 mm. **10**

Find: (1) Thickness of the head (2) Weight of this head.

(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: **14**
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 m, Diameter of half coil = 6 cm, Width of channel jacket = 5.8 cm, Internal design pressure for shell = 4 kgf/cm², Internal design pressure for jacket = 2 kgf/cm², MOC for both shell and jacket is same.

Max. allowable stress for MOC = 980 kgf/cm², Modulus of elasticity, E, for MOC = 19×10^5 kgf/cm², Poisson's ratio, μ = 0.3, J = 0.85, Corrosion allowance = 2 mm.

OR

- Q.4 (a)** Data for pressure vessel are given below: **10**
Capacity: 10000 L (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.
R₁ = 10% of 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**
