

B.TECH. DEGREE EXAMINATIONS: NOV/DEC 2010

Seventh Semester

BIOTECHNOLOGY

U07BTE14: Process Equipments and Plant Design

Time: Three Hours

Maximum Marks: 100

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. In a shell and tube heat exchanger, the shortest centre to centre distance between the adjacent tubes is
 - (a) called tube pitch
 - (b) called tube clearance
 - (c) always less than the diameter of the tube
 - (d) none of the above
2. For evaporation of a viscous solution in a multiple effect evaporator, the preferred feeding scheme is
 - (a) forward
 - (b) backward
 - (c) parallel
 - (d) none of these
3. Cylindrical storage tanks used for the storage of volatile liquids have _____ roofs.
 - (a) conical
 - (b) flat
 - (c) floating
 - (d) fixed
4. Vertical vessels are not supported by
 - (a) brackets
 - (b) skirts
 - (c) columns
 - (d) saddles
5. For absorbers, high pressure drop results in
 - (a) increased efficiency
 - (b) decreased efficiency
 - (c) high operating cost
 - (d) better gas liquid contact
6. Plate efficiency
 - (a) is a function of the mass transfer between liquid and vapour
 - (b) increases due to foaming
 - (c) increases due to liquid entrainment
 - (d) increases due to weeping and dumping of liquid
7. Diaphragm pumps are used to transport
 - (a) solids
 - (b) liquids
 - (c) fluids
 - (d) slurries
8. L_e/D for fully open globe valve may be around
 - (a) 10
 - (b) 25
 - (c) 75
 - (d) 300
9. ASME code B31.3 refers to
 - (a) Power piping
 - (b) Fuel gas piping
 - (c) Process piping
 - (d) Refrigeration piping
10. Lower BWG means _____ of the tube
 - (a) lower thickness
 - (b) lower cross-section
 - (c) outer diameter
 - (d) inner diameter

PART B (10 x 2 = 20 Marks)

11. What are the factors to be considered for routing the fluid in a shell and tube heat exchanger?
12. What are the advantages of forced circulation evaporators?
13. What are the various types of flange used in process industries?
14. What are the various types of vessel support used in process industries?
15. What are the steps followed in distillation column design?
16. How is extraction equipments classified?
17. How are pumps classified?
18. How are valves classified?
19. Define schedule number.
20. Give various ASME piping codes.

PART C (5 x 14 = 70 Marks)

21. a) In a 1-1 counter flow shell and tube heat exchanger, a process stream ($C_p = 4.2$ KJ/Kg.K) is cooled from 450 to 350 K using water ($C_p = 4.2$ KJ/Kg.K) at 300 K. The process stream flows on the shell side at a rate of 1 kg/sec. and the water on the tube side at a rate of 5 kg/sec. If heat transfer coefficients on the shell and tube are 1000 and 1500 W/m².K respectively, determine (a) the required heat transfer area (b) by what factor will the required area change if the flow is co-current. Neglect tube wall and fouling resistances.

(OR)

- b) Calculate the amount of steam required for concentrating the solution of caustic soda from 28% to 40% W of solids in a single effect evaporator. The feed rate is 25000 kg/hr and its temperature is 60°C. The absolute pressure in the evaporator is 0.2 kg/cm²(boiling point 60°C). Saturated steam at 1.4 kg/cm² (108.7°C) is to be used as heating medium. The elevation in boiling point is 25°C. If the overall heat transfer coefficient is 670 kcal/hr.m².°C, calculate the heating surface required. The enthalpy data are; vapour at 0.2 kg/cm² is 623 kcal/kg, 28% NaOH at 60°C is 50 kcal/kg, 40% NaOH at 85°C is 90 kcal/kg and latent heat of steam at 1.4 kg/cm² is 534 kcal/kg.

22. a) Explain in detail about design considerations of pressure vessels.

(OR)

- b) Explain in detail about vessel supports with a neat diagram.

23. a) A continuous fractionating column is to be designed to separate 350 gm moles per minute of binary mixtures containing 40% of benzene and 60% of toluene (by weight). The top product contains 97% (by weight) of benzene and the bottom product contains 98% (by weight) toluene. A reflux ratio of 3.5 moles to 1 mole of product is to be used. The feed is a liquid entering the column at its boiling point.

(i) Determine the number of ideal plates.

(ii) Calculate the moles of overhead product and bottom product.

Equilibrium data:

x	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0.0	0.185	0.36	0.50	0.61	0.70	0.78	0.84	0.90	0.95	1.0

(OR)

b) 5000 kg/hr of a SO_2 - air mixture containing 5% by volume SO_2 is to be scrubbed with 200000 kg/hr of water in a packed tower. The exit concentration of SO_2 is reduced to 0.15%. The tower operates at 1 atmosphere. The equilibrium relationship is given by $Y = 30 X$, where $Y = \text{mole } \text{SO}_2 / \text{mole air}$; $X = \text{mole } \text{SO}_2 / \text{mole water}$. If the packed height of the tower is 420 cm, estimate the height of transfer unit (H.T.U).

24. a) With a neat diagram, explain the construction and working of centrifugal pump.

(OR)

b) With a neat diagram, explain the construction of various types of valves.

25. a) Explain in detail about mechanical design of piping systems.

(OR)

b) Explain about the plant layout and what are the factors to be considered?
