Total No. of Questions :10]

SEAT No. :

P2903

[Total No. of Pages :3

[4958]-1098
T.E. (Chemical)
CHEMICAL ENGINEERING DESIGN - I
(2012 Course) (End - Semester) (309350) (Semester - II)

Time : 2½ Hours] *[Max. Marks :70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6,Q.7 or Q.8, Q.9 or Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q1) Design the skirt support for a cylindrical vertical vessel with the help of following data: **[10]**

Diameter of the vessel = 3000 mm

Height of the vessel = 37,500 mm

Weight of the vessel with attachments = 2,00,000 kg

Diameter of skirt = 3000 mm

Height of skirt = 4800 mm

Wind pressure = 1285 N/mm^2

Permissible stress = 140 N/mm^2

Yield point = 200 N/mm^2

Permissible stress of concrete = 35 N/mm^2.

OR

Q2) A storage vessel is to be covered by using a conical roof. Check the suitability of 10mm thick plates for the construction of conical roof with permissible slope of 1 in 5. Superimposed load = 1250 N/m^2, density of steel = 7700 kg/m^3. Diameter of vessel is 10m. If the plates are not suitable, suggest the required thickness for roof plates. **[10]**

P.T.O.

Q3) a) Discuss the step by step method for designing Shell and Tube Heat Exchanger? **[7]**

b) Write a short note on LMTD Correction factor? **[3]**

OR

Q4) a) Give the step by step method for designing of rectangular tanks as per IS:804? **[5]**

b) Discuss in detail classification of vessel supports? **[5]**

Q5) 15,000 kg/hr of liquid with 10% solids available at 21°C is to be concentrated to 50% solids. The vacuum can be used at 13.3 kN/m^2. BPR of the solution can be neglected. Design the evaporator as triple effect with backward feed arrangement. Heat capacity of solution = 4180 K/kg K, Temperature of steam at 205 kN/m^2 = 121°C, Temperature of steam at 13.3 kN/m^2 = 52°C, Latent heat of steam at 121°C = 2200 kJ/kg, Latent heat of steam at 52°C = 2377 kJ/kg
OD of the tube = 75 mm, Length of the tube = 2.0m
Overall heat transfer coefficient are U_1 = 2500 W/m^2 K, U_2 = 2000 W/m^2 K, U_3 =1600 W/m^2 K. Arrangement of the tubes is square pitch with centre to centre distance equal to 1.25 times the OD of the tube. **[18]**

OR

Q6) a) Write a short note on: **[8]**

i) Condensation inside and outside vertical tubes.

ii) Condensation of mixtures.

b) Make a preliminary design for a vertical thermosyphon for a column distilling crude aniline. The column will operate at atmospheric pressure and a vaporisation rate of 6000 kg/h is required. Steam is available at 22 bar (300 psig). Take the column bottom pressure as 1.2 bar.

Physical properties, taken as those of aniline: Boiling point at 1.2 bar 190°C. Molecular weight 93.13, Tc = 699 K, Latent heat 42,000 kJ/kmol, Steam saturation temperature 217°C. Design heat flux = 25,000 W/m^2, shell diametrical clearance = 14 mm. **[10]**

Q7) a) Explain in detail various types of agitators and their selection criteria. **[8]**

b) Calculate the diameter of the shaft for an agitation system. The horse power required is 3. Torque acting over shaft is 18,900 kg.m, while bending moment is 27,700 kg.m, Permissible shear and tensile stresses are 400 and 600 kg/cm^2 respectively. **[8]**

OR

Q8) a) Calculate the diameter of the shaft used in agitation system. Torque acting over the shaft is 1,15,000 kg.cm while bending moment acting over the shaft is 34,600 kg.cm. Factor of safety = 6. Ultimate tensile strength of materials of shaft = 6,900 kg/cm^2. Ultimate shear stress is 75% of UTS. **[8]**

b) Explain different types of jacket with neat sketches and design of plain jacket. **[8]**

Q9) Write short notes on: **[16]**

a) Knock-out drum

b) Decanter

c) Gravity separator

d) Liquid-liquid separators

OR

Q10)a) Make a preliminary design for a separator to separate a mixture of steam and water. Steam flow rate is 2500 kg/h and water flow is 1250 kg/h. Operating pressure is 4.2 bar. Liquid density = 950 kg/m^3, Vapour density = 2.5 kg/m^3. Design the separator with demister pad. **[10]**

b) Explain the importance of column auxiliaries. **[6]**

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