

BACHELOR OF TECHNOLOGY (C.B.C.S.) (2014 COURSE)
B.Tech.Sem - VI CHEMICAL : WINTER- 2022
SUBJECT : CHEMICAL PROCESS EQUIPMENT DESIGN-I

Day : Friday

Time : 10:00 AM-01:00 PM

Date : 25-11-2022

W-13509-2022

Max. Marks : 60

N.B.

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate **FULL** marks.
- 3) Draw neat and labeled diagram **WHEREVER** necessary.
- 4) Assume suitable data, if necessary.

Q.1 Discuss various mechanical properties of the material used for construction of process equipment's. (10)

OR

Q.1 What are various general design parameters for the design of process equipment? (10)

Q.2 State the design equation for a pressure vessel under external pressure and inside vacuum? Discuss the design procedure. (10)

OR

Q.2 Design a vessel subjected to external pressure of 0.1 N/mm^2 (inside vacuum) having following data (10)

- a) assume shell thickness 12 mm
- b) modulus of elasticity (carbon steel) $E = 19.0 \times 10^4 \text{ N/mm}^2$
- c) nominal diameter $D_o = 3764 \text{ mm}$
- d) permissible stress for (C.S.) = 98 N/mm^2
- e) length of the vessel – 3000 mm

Q.3 What are saddle supports? Explain with neat sketch. How various stresses and bending moments are calculated for saddles? (10)

OR

Q.3 What are the loads considered while evaluating the skirt thickness and how is skirt thickness calculated? (10)

Q.4 Design 1-1 H.E. for water flow with the following data (10)

- a) Working press = 0.5 N/mm^2
- b) Design press = 0.60 N/mm^2
- c) Temperature inlet – 40°C
- d) Temperature outlet – 60°C
- e) Crown radius for Shell side head – 500 mm
- f) Gasket material – Asbestos
- g) Bolt material – steel
- h) Permissible stress for shell. Material (carbon steel) – 95 N/mm^2
- i) Permissible stress for Bolt. Material (carbon steel) – 140.6 N/mm^2

Tubes –

Tubes material of construction – (S.S.- 304)

No. of tubes – 60

O.D. of tubes – 20 mm

Length of tube – 15 mm

Pitch – (square) – 25 mm

Fluid (Gas) –

Working press – 20 N/mm^2

Inlet temp. – 180°C

Outlet temp – 60°C

Permissible stress – 110.6 N/mm^2

OR

Q.4 Explain design equations for the calculation of number of tubes, pressure Drop on tube side and shell side, shell thickness, Bolts and Gasket design. (10)

P.T.O.

Q.5 Summarize the design considerations for the design of agitator system. (10)

OR

Q.5 Elaborate the importance of position of turbines in turbine agitators, also outline different types of turbine agitators. (10)

Q.6 A horizontal cylindrical continuous decanter is to separate 9.93 m³/hr of a liquid petroleum fraction from an equal volume of wash acid. The oil is the continuous phase and at the operating temperature have a viscosity of 1.1 cp and a density of 865 Kg/m³. The density of acid is 1153 Kg/m³. (10)

Compute

i) The size of vessel

ii) The height of acid overflow above the vessel floor

OR

Q.6 Summarize the design considerations for evaporations equipment's. Design a double effect forward feed evaporator with heat transfer area calculations. (10)

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