Time: 3 Hours   Total marks: 80

N.B.: (1) Question No 1 is compulsory
     (2) Attempt any three questions out of remaining five questions
     (3) Assume suitable data if necessary and indicate it clearly.
     (4) Figures to the right indicate full marks.

Q1. Solve any four questions   20

    (a) Explain codes and standards for equipment design

    (b) Explain classification of heat exchangers.

    (c) Explain weld joint efficiency and corrosion allowance.

    (d) Explain various ferrous and nonferrous materials of construction

    (e) Explain ultrasonic nondestructive testing method.

Q2. (a) Write a design procedure with relevant equations for evaporator.   10

  (b) Explain shrink fit and auto-frettage construction of high pressure vessel.   10

Q3. (a) Design a fixed tube sheet heat exchanger having the following data   10
        Shell design pressure = 0.5 N/mm^2
        Permissible stress for shell material = 95 N/mm^2
        Corrosion allowance for shell material = 1.5mm
        Tube design pressure = 1.5 N/mm^2
        Tube outside diameter = 20mm
        Tube pitch = square
        Tube length = 2500mm
        Number of tubes = 40
        Number of passes on tube side = 2 $\beta = 0.7$
        Shell flange:
        Raised facing Gasket used is flat metal jacketed asbestos filled
        Design seating stress = 53.4 N/mm^2
        Gasket Factor = 3.75
        Allowable stress for bolt material = 138 N/mm^2
        Design should include
        i)   Shell
        ii)   Shell Flange

  (b) Explain different types of supports used in process industries.   10

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Q4 (a) A tall vertical column 2.5 m in outer diameter and 42 m in height is to be installed. The available specifications are: **10**

Operating temperature and pressure – 160°C and 4 kg/cm^2

Skirt height – 3.0 m.

Tray spacing – 0.6 m.

Top space disengagement – 1.2 m.

Weir height – 60 mm.

Bottom space separation – 1.8 m

Tray loading with liquid – 110 kg/m^2

Tray support ring – 45 mm x 45mm x 11 mm angles

Corrosion allowance – 1.5 mm

Wind force acting over vent – 110 kg/m^2

Design pressure – 4 × 1.2 = 4.8 kg/cm^2

Insulation thickness – 120 mm.

Permissible material stress of shell – 780 kg/m^2.

Welded joint efficiency – 0.80

Density of shell material. – 7600 kg/m^3.

Density of insulation – 500 kg/m^3.

Overhead vapor pressure line – 2280 mm

Weight of ladder – 30 kg/m.

Weight of 280 mm outer diameter pipe – 60 kg/m

(b) Explain different column internals for packed and tray column with neat and labelled diagram **10**

Q 5 (a) List out types of NDT methods. Explain Radiography in detail with neat diagram **10**

(b) Which are the different losses while storing the volatile liquids? Explain different types of storage vessels used for storing volatile liquids. **10**

Q6. (a) Write a design of agitation system .Design should include **12**
  i.   Design of shaft
  ii.   Design of stuffing box and glands

(b) Explain different types of jackets used for reaction vessels. **08**

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