

(3 Hours)

(Total Marks : 80)

**N. B. : 1) Question No. 1 is compulsory.****2) Solve any three questions from question Nos. 2 to 6.****3) Figures to the right indicate full marks.****4) Assume suitable data wherever necessary but justify the same.****1. Explain any four :****20**

- Difference between U-tube and Fixed tube heat exchangers.
- Shrink fit construction of high-pressure vessel.
- Elastic stability for tall column.
- Design of buried pipeline.
- Explain Spray Dryer.

**2. (a) Design a fixed tube sheet heat exchanger having the following data :****20**Shell design pressure = 0.6 N/mm<sup>2</sup>Permissible stress for shell material = 95 N/mm<sup>2</sup>Tube design pressure = 2 N/mm<sup>2</sup>

Tube outside diameter = 20 mm

Tube Pitch = Triangular

Tube length = 2500 mm

Number of tubes = 40

Number of passes on tube side = 2

Shell flange Raised facing Gasket used is flat metal jacketed asbestos filled

Design seating stress = 53.4 N/mm<sup>2</sup>

Gasket factor = 3.75

Allowable stress for bolt material = 138N/mm<sup>2</sup>Channel flange Permissible stress for flange material = 100N/mm<sup>2</sup>

Joint with tubesheet = Ring facing

Gasket factor =5.5

Design seating stress for gasket =126.6 N/mm<sup>2</sup>

Design should include (i) shell (ii) Tubesheet (iii) Shell flange (iv) Channel flange (v) Channel and Channel cover

**3. (a) Write a detail design procedure with relevant equations for standard vertical calendria type evaporator.****14****(b) Explain standard vertical short tube evaporator with neat sketch.****06**

4. (a) A closed vessel is to be designed to withstand an internal design pressure of  $150 \text{ N/mm}^2$ . An internal diameter of  $300 \text{ mm}$ . Following properties may be assumed Yield strength =  $700 \text{ N/mm}^2$ , Ultimate Tensile strength =  $500 \text{ N/mm}^2$ , Poisson's ratio =  $0.3$ , Estimate the wall thickness by using factor of safety  $1.5$  based on yield strength on the basis of : **10**
- Maximum Principal Stress theory.
  - Maximum Shear stress Theory.
  - Maximum Principal strain Theory.
  - Distortion energy theory.
- (b) Explain material of construction for high pressure vessel. **05**
- (c) Estimate the optimum diameter of a pipe for allowing the flow of a liquid at the rate of  $10.5 \text{ kg per second}$ , when the temperature is  $26^\circ\text{C}$  and the other data is as below : **05**
- Density of the liquid =  $1105 \text{ kg/m}^3$ .  
 Viscosity of the liquid =  $1.15 \times 10^{-3} \text{ Nsec/m}^2$ .  
 Material of pipe = carbon steel.  
 Also determine whether the flow of the liquid is laminar or turbulent.
5. (a) Explain design procedure for determination of shell thickness at different heights for distillation column. **15**
- (b) Describe different types of packing used in packed column. **05**
6. (a) Explain piping and instrumentation diagram and draw P & ID for single reactor. **10**
- (b) Explain in detail Rotary disc filters with its parts. **10**