

# CBCS SCHEME

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**18CH54**

## Fifth Semester B.E. Degree Examination, July/August 2021 Chemical Equipment Design

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions.  
2. Use of IS code 2825 – 1969 handbook is permitted.**

- 1
  - a. Explain general design procedure with design flow diagram. (08 Marks)
  - b. Explain the various factors considered in satisfactory design. (12 Marks)
- 2
  - a. Explain stresses due to static and dynamic loads. (10 Marks)
  - b. A pressure vessel having 2m ID, 3m height in operating at pressure of 100mm Hg and outside pressure is 1 atmosphere. Vessel is operating under 130°C having material specification IS 2002 – 1962 2A. Design a suitable shell, where  $E = 19 \times 10^{10} \text{ N/m}^2$  and  $\mu = 0.3$ . (10 Marks)
- 3
  - a. Discuss types of supports used for vessel with neat sketches. (10 Marks)
  - b. How flanges are classified? Explain briefly with neat sketches. (10 Marks)
- 4
  - a. Explain the importance of gasket briefly with design procedure. (10 Marks)
  - b. Estimate the (B0 – 10) dished head, Elliptical head with 2 : 1 and conical head with 100°C apex angle, for a cylindrical shell of 1.5m ID and 2m height operating oil 14 bar and 250°C. (10 Marks)
- 5
  - a. What are the process conditions and design procedure for storage of fluids, in storage tanks. (10 Marks)
  - b. Explain different types of roofs used for design of storage vessels with neat sketches. (10 Marks)
- 6
  - a. List out the different losses in storage vessel. Explain briefly. (08 Marks)
  - b. A cylindrical storage tank has diameter 30m and the tank height is 15m. Liquid stored in the tank has density 810kg/m<sup>3</sup>. Material of Construction (MOC) is carbon steel having permissible stress 1300kg/cm<sup>2</sup>. Density of material used for fabrication is 7700kg/m<sup>3</sup>. The plate size 3m × 1.2m in varying thickness. Calculate this cylindrical shell thickness of the tank at different heights, also estimate total number of plates required. (12 Marks)
- 7
  - a. Explain the concept of mixing and agitation with different types of agitators with neat sketches. (10 Marks)
  - b. Design a turbine agitator with six blades, installed centrally. The tank is 2m diameter, turbine is 0.61m in diameter and is positioned 0.61m from the bottom of the tank. Height of the liquid is 1.83m viscosity of fluid 15CP, density of liquid 1500kg/m<sup>3</sup>, speed of agitator  $n = 90\text{rpm}$ , length of agitator shaft between bearing and agitator 2.1m, width of the blade 12mm, number of baffles at tank wall is 4, ultimate tensile stress 4200kgs/cm<sup>2</sup> maximum allowable shear stress in shaft 550kgt/cm<sup>2</sup>,  $E = 19.5 \times 10^5 \text{ kgf/cm}^2$ . Take power number = 6. Determine : i) Power required for agitation ii) Shaft diameter. (10 Marks)

- 8 a. Calculate the diameter of the shaft used in an agitation system. Torque acting over the shaft 115000kg-cm, while bending moment acting over the shaft 34600kg.cm. Ultimate tensile strength of shaft material is  $6900\text{kg/cm}^2$ , ultimate shear stress is 75% of ultimate tensile stress. Factor of safety is 6. (10 Marks)
- b. Explain different types jackets used for design of reaction vessel with neat sketches. (10 Marks)
- 9 a. Write step by step procedure to design a tall vertical vessel. (12 Marks)
- b. Explain the different types of stresses acting on tall vertical vessel. (08 Marks)
- 10 Write a notes on :
- a. P and I diagram
- b. Pipe fittings and symbols
- c. Optimum size of pipe
- d. Pipe schedule number. (20 Marks)

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