

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Mechanical Design of Process equipments- 3170514

Unit 1: Introduction

Repeated Questions:

1. **Define/Explain Design Pressure and Design Temperature.**
 - Appeared in: W23 (Q1a, 03 marks), W22 (Q1a, 03 marks), S22 (Q1a, 03 marks)
2. **Explain the "Radiography Test" for pressure vessels.**
 - Appeared in: S22 (Q1b, 04 marks), W24 (Q1b, 04 marks), S23 (Q2c-ii, part of 07 marks), SUM25 (Q3b, part of 07 marks)
3. **Define the following mechanical properties: Creep, Toughness, Poisson's Ratio, Resilience.**
 - Appeared in: S22 (Q2c, part of 07 marks), SUM25 (Q2c, 07 marks), S24 (Q1c, 07 marks), W22 (Q1b, 04 marks), W24 (Q1a, 03 marks), S23 (Q2a, 03 marks)
4. **State and discuss the various types of gaskets used in industries.**
 - Appeared in: S23 (Q1c, 07 marks), W24 (Q3b, 04 marks), W23 (Q1c, 07 marks), SUM25 (Q3b, 04 marks)
5. **Give the full form of ASME, TEMA, API, ASTM, ANSI, HTRI.**
 - Appeared in: W23 (Q8a, 03 marks), SUM25 (Q3a, 03 marks), S24 (Q2b, 04 marks), W22 (Q2a, 03 marks)

Other Important Questions:

6. What is a pressure vessel? State examples. (S23 - Q1a, 03 marks)
7. Differentiate between fatigue and creep. (S23 - Q2a, 03 marks)
8. Define: Ductility, Elasticity. (W24 - Q1a, 03 marks)
9. Define: Hardness, Yield Stress, Ultimate Stress, Fatigue. (S24 - Q1c, 07 marks)
10. Define Weld Joint Efficiency Factor. (W23 - Q2a, part of 03 marks)
11. Discuss the advantages and disadvantages of a flanged joint over a welded joint. (W23 - Q2b, part of 03 marks), (SUM25 - Q2a, 03 marks)
12. Enlist various types of fabrication techniques used in industries. Explain any one in detail. (W22 - Q1c, 07 marks), (S24 - Q1b, 04 marks)
13. Discuss the term: Moment of Inertia. (W23 - Q7a, part of 03 marks)

14. Discuss the term: Power Number. (W24 - Q2a, part of 03 marks), (S24 - Q1a, part of 03 marks)
15. What is design stress and factor of safety? Explain briefly. (W24 - Q2b, 04 marks), (W22 - Q3a, 03 marks)
16. Discuss the Stress vs Strain curve. (W22 - Q3a, 03 marks)
17. Classify unfired pressure vessels as per IS-2825. (S22 - Q2a, 03 marks), (S23 - Q2c-i, part of 07 marks), (W24 - Q1c, part of 07 marks), (S24 - Q2c, 07 marks)
18. Define Gasket, Gasket seating stress, and Gasket factor. (S24 - Q2a, 03 marks), (W22 - Q2b, 04 marks), (W24 - Q5a, 03 marks)
19. Discuss different types of static and rotary equipment used in the industry. (W24 - Q2c-OR, 07 marks)

Unit 2: Design of Pressure Vessels

Repeated Questions:

1. **Derive the equation for longitudinal and circumferential stresses in a cylindrical shell under internal pressure.**
 - Appeared in: W23 (Q6c, 07 marks), S22 (Q2b, 04 marks), S23 (Q1b, 04 marks)
2. **Discuss the analytical/graphical method for thickness calculation of a shell subjected to external pressure.**
 - Appeared in: W23 (Q6a, 03 marks), SUM25 (Q1a, 03 marks)
3. **State the applications of various types of heads (closures) used for pressure vessel design.**
 - Appeared in: S22 (Q3a, 03 marks), S24 (Q3a, 03 marks)
4. **Discuss different types of nozzles and their selection criteria. / Discuss the design of a reinforcement pad for a nozzle by the area-for-area method.**
 - Appeared in: W23 (Q4c, 04 marks), SUM25 (Q3c, Numerical), W24 (Q4c, Numerical), S24 (Q3c, Numerical)
5. **Discuss different types of flanges and flange facings.**
 - Appeared in: W23 (Q4a, 03 marks), W24 (Q2c, 07 marks), SUM25 (Q5c, 07 marks)
6. **Discuss the mechanical design of Elliptical Head.**
 - Appeared in: W24 (Q3a, 03 marks), S24 (Q3b-OR, 04 marks)

Other Important Questions:

7. "Circumferential stress is always less than axial stress for a cylindrical vessel subjected to internal design pressure." Appreciate/Criticize this statement with derivation. (SUM25 - Q2b, 04 marks)
8. Define longitudinal stress and circumferential stress. (W24 - Q1c, part of 07 marks), (S24 - Q2c, 07 marks)
9. Discuss the mechanical design of Hemispherical Head. (W24 - Q3b-OR, 04 marks)
10. Discuss the mechanical design of Torispherical Head. (W22 - Q3b, 04 marks)
11. With a neat sketch, show crown radius, knuckle radius, and straight flange portion in a Torispherical head. (W24 - Q3a-OR, 03 marks)
12. Discuss Flat Heads. (W23 - Q4b, 03 marks)
13. Discuss Conical Heads. (W23 - Q5b, 03 marks)
14. Discuss different methods for a shell subjected to external pressure. (W23 - Q5c, 03 marks)
15. Discuss the requirement of stiffening rings in pressure vessels. (S24 - Q3a-OR, 03 marks)
16. State the purpose of providing a reinforcement pad for a nozzle. (S22 - Q3a, 03 marks), (S23 - Q4a, 03 marks)
17. Write a short note on Safety Valves. (W23 - Q6b, 03 marks)
18. **Numerical on Vessel under External Pressure/Vacuum:** (S22 - Q2c, 07 marks)
19. **Numerical on Head Thickness/Volume/Weight Calculation:** (W22 - Q3c, 07 marks)

Unit 3: Design of Reaction Vessels

Repeated Questions:

1. **Discuss different types of agitators and their selection criteria.**
 - Appeared in: SUM25 (Q1c, 07 marks), W22 (Q2c, 07 marks), S23 (Q3b, 04 marks)
2. **Discuss different types of jackets and their selection criteria.**
 - Appeared in: W23 (Q7c, 03 marks), SUM25 (Q5b, 03 marks), W22 (Q3b, 04 marks), S22 (Q3b, 04 marks)
3. **Numerical on calculating Power Required and Shaft Diameter for an Agitator.**
 - Appeared in: W24 (Q3c-OR, 07 marks), S23 (Q3-OR, 07 marks)

Other Important Questions:

4. State the various types of agitators. Discuss the design aspects of any one agitator in detail. (S22 - Q3b, 04 marks)
5. With a neat sketch, explain the uses of various types of jackets for a reaction vessel. (S24 - Q3b, 04 marks)
6. With a neat sketch, explain the various types of jackets and discuss the design of channel jacket and half coil jacket. (S23 - Q3c, 07 marks)
7. Define for agitation: Power number, Froude number, and Reynolds number. (SUM25 - Q5b, 03 marks)
8. Discuss the flow pattern for axial flow and radial flow impellers and the importance of baffles. (S24 - Q2c, 07 marks)
9. Discuss the design steps for the calculation of tube-side heat transfer coefficient and pressure drop. (W24 - Q3c, 07 marks), (W22 - Q3c, 07 marks)
10. **Numerical on Jacketed Reactor Design:** (SUM25 - Q4, 14 marks)

Unit 4: Design of Storage Tanks

Repeated Questions:

1. **Explain Normal and Emergency venting for a storage vessel.**
 - Appeared in: S22 (Q4a, 03 marks), SUM25 (Q3a, 03 marks), W24 (Q4a, 03 marks), W22 (Q4a, 03 marks)
2. **Discuss External Floating Roof Storage Tank.**
 - Appeared in: S22 (Q4b, 04 marks), S23 (Q4b, 04 marks), W24 (Q4b, 04 marks), S24 (Q4a-OR, 03 marks)
3. **Discuss the design of a structural-supported (conical) roof as per API 620.**
 - Appeared in: S22 (Q4c, 07 marks), S24 (Q4c-OR, 07 marks), W24 (Q4c-OR, 07 marks)
4. **Discuss wind girders for large open tanks.**
 - Appeared in: S22 (Q4b, 04 marks), S23 (Q4a-OR, 03 marks), S24 (Q4b-OR, 04 marks)
5. **Numerical on determining shell plate thickness and number of plates for a Storage Tank.**
 - Appeared in: S23 (Q4c, 07 marks), W22 (Q4c, 07 marks), S24 (Q4c, 07 marks), SUM25 (Q3c, Numerical)

Other Important Questions:

6. What is the function of a dyke wall in a storage tank? (S22 - Q4a, 03 marks), (S24 - Q4a, 03 marks)
7. Discuss Fixed Roof Storage Tanks. (W23 - Q7b, 03 marks)
8. Discuss the importance of sealing strips. (W24 - Q4a-OR, 03 marks), (S24 - Q5a, 03 marks), (W22 - Q4a, 03 marks)
9. **Numerical on Fixed Conical Roof Thickness:** (S22 - Q4c, 07 marks)

Unit 5: Design of Shell & Tube Heat Exchangers

Repeated Questions:

1. **Explain the function of the following parts: (i) Baffles (ii) Tie Rods (iii) Spacers (iv) Expansion Joint (v) Tube Sheet.**
 - Appeared in: W23 (Q1c, 07 marks), SUM25 (Q5a, 03 marks), W24 (Q5a-OR, 03 marks), W22 (Q5a, 03 marks)
2. **Discuss the general/mechanical design steps for a shell and tube heat exchanger.**
 - Appeared in: S23 (Q4c, 07 marks), S24 (Q3c-OR, 07 marks)
3. **Discuss the design of Saddle Support.**
 - Appeared in: W23 (Q5c-OR, 07 marks), W24 (Q4c-OR, 07 marks), W22 (Q4b, 04 marks)

Other Important Questions:

4. Explain the function of a Tube Side Pass Partition. (W23 - Q1c, part of 07 marks)
5. Discuss the design steps for the calculation of the overall heat transfer coefficient. (S24 - Q3c-OR, 07 marks)

Unit 6: Design of Distillation and Absorption Columns

Repeated Questions:

1. **Explain the different types of stresses induced in the shell of a distillation column.**
 - Appeared in: S22 (Q5c, 07 marks), S24 (Q5c, 07 marks), S23 (Q5c, 07 marks)
2. **Name and explain the various types of tray supports.**
 - Appeared in: W23 (Q8b, 03 marks), S22 (Q5a, 03 marks), S23 (Q5a, 03 marks), S24 (Q4b, 04 marks)
3. **Discuss the stepwise design procedure for a Skirt Support.**
 - Appeared in: SUM25 (Q5c, 07 marks), W22 (Q5c, 07 marks)
4. **Major Numerical on the design of a Distillation Column (thickness and stress analysis).**
 - Appeared in: S22 (Q5-OR, 14 marks), S23 (Q5-OR, 14 marks), SUM25 (Q4-OR, 14 marks), S24 (Q5-OR, 14 marks), W22 (Q5, 14 marks)

Other Important Questions:

5. State and explain various types of distillation columns and their parts. (W23 - Q5b-OR, 04 marks)
6. When is a skirt support used? State any two advantages over a bracket support. (S23 - Q5b, 04 marks)
7. Explain the design procedure for a Bracket Support. (W23 - Q5c-OR, 07 marks)
8. State the advantages and limitations of a bracket support. (S23 - Q3a, 03 marks)
9. Write in detail about the types of packings used in a packed column. (W23 - Q8c, 07 marks)
10. **Numerical on Saddle Support Design:** (S22 - Q3c, 07 marks)
11. **Numerical on Skirt Support Thickness:** (W24 - Q5c-OR, 07 marks)
