

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Name & Code:

Process Equipment Design- 3170502

Unit 1: Process Design of Piping and Pumps

Repeated Questions:

1. **Define NPSH and give its importance for pump design.**
 - Appeared in: W22 (Q1a, 03 marks), S24 (Q2a, 04 marks)
2. **Explain the concept of NPSH in a pumping system. Distinguish between (NPSH)A and (NPSH)R. If (NPSH)A is less than (NPSH)R, suggest corrective actions.**
 - Appeared in: W24 (Q1b, 04 marks)
3. **Discuss the five standard locations of pressure taps in an orifice meter.**
 - Appeared in: S24 (Q1b, 04 marks), W24 (Q5c part-1, 07 marks)
4. **Calculate (NPSH)A and the power required by a centrifugal pump for a given system.**
 - Appeared in: S22 (Q2c, 07 marks), S23 (Q1c, 07 marks), S24 (Q1c, 07 marks), S25 (Q2c, 07 marks)
 - *Note: This is a numerical problem type that appears frequently with different fluids (Benzene, Hexane).*

Other Important Questions:

5. **Define: 1. The capacity of a pump, 2. NPSH, 3. Schedule number.**
 - Appeared in: S22 (Q1a, 03 marks)
6. **Define Equivalent Length.**
 - Appeared in: S23 (Q1a, 03 marks)
7. **Explain in brief about the equivalent length of pipes.**
 - Appeared in: W22 (Q1b, 04 marks)
8. **Justify the effects of a larger diameter pipe on operating cost and fixed cost.**
 - Appeared in: S23 (Q1b, 04 marks)
9. **With a neat sketch, explain the pressure tapes in the orifice meter.**
 - Appeared in: S22 (Q1c, 07 marks)
10. **Find out the power required for a turbo blower for a given duty and find the discharge temperature of air.**
 - Appeared in: W22 (Q1c, 07 marks)
11. **Calculate the differential pressure across an orifice meter for given data.**
 - Appeared in: S25 (Q2 OR-c, 07 marks)
12. **A rotameter tube has an internal diameter of 40 mm at top and 25 mm at the bottom... Calculate the flow rate.**
 - Appeared in: W23 (Q1c, 07 marks)
13. **It is proposed to pump 10000 kg/h of saturated toluene... Calculate the power required to drive the pump.**
 - Appeared in: W23 (Q2c, 07 marks)
14. **A three-stage reciprocating compressor is used to compress 306 Sm³/h of methane... Calculate the power required.**
 - Appeared in: S22 (Q2 OR-c, 07 marks)

Unit 2: Process Design of Heat Exchangers

Repeated Questions:

1. **Discuss the criteria for fluid allocation in shell and tube heat exchangers.**
 - Appeared in: S25 (Q3a, 03 marks), W24 (Q3a, 03 marks), S24 (Q1a, 03 marks)
2. **What are the functions of baffles in shell and tube heat exchangers? Discuss in brief the types of baffles.**
 - Appeared in: S22 (Q1b, 04 marks), S23 (Q2a, 03 marks)
3. **Explain the effect of baffle cut and baffle spacing on the shell side heat transfer coefficient.**
 - Appeared in: W24 (Q1a, 03 marks), S23 (Q2b, 04 marks), W22 (Q2a, 03 marks)
4. **Explain Tinker's flow model with a neat diagram.**
 - Appeared in: W23 (Q3 OR, 07 marks), S25 (Q3b, 04 marks), W24 (Q3b, 04 marks), S24 (Q4b, 04 marks)
5. **Discuss the criteria of selection between kettle type reboiler and thermosyphon reboiler.**
 - Appeared in: S22 (Q3b, 04 marks), S25 (Q3b, 04 marks), S23 (Q2 OR-c, 07 marks)
6. **Discuss the advantages and disadvantages of plate-type heat exchangers over shell and tube heat exchangers.**
 - Appeared in: S22 (Q2b, 04 marks), S24 (Q3b, 04 marks), S25 (Q3 OR-a, 03 marks)

Other Important Questions:

7. **Give the full names for TEMA, ASME, and BEM/HTRI.**
 - Appeared in: W23 (Q2a, 03 marks), S22 (Q2a, 03 marks)
8. **Discuss in brief the various heating and cooling media used in shell and tube heat exchangers.**
 - Appeared in: W23 (Q1b, 03 marks), S23 (Q3c, 07 marks)
9. **Why is an expansion joint provided in a fixed tube sheet heat exchanger?**
 - Appeared in: S23 (Q3a, 03 marks), S24 (Q3 OR-a, 03 marks)
10. **What is the significance of the temperature correction factor? How is it calculated?**
 - Appeared in: S22 (Q3a, 03 marks)
11. **Suggest modifications to avoid temperature cross in a shell and tube heat exchanger.**
 - Appeared in: S25 (Q2a, 03 marks)
12. **Discuss merits and demerits of saturated steam over hot oil as a heating medium.**
 - Appeared in: S25 (Q1a, 03 marks)
13. **Appreciate/criticize: "Superheated steam is preferred over saturated steam as a heating medium due to its higher heat transfer coefficient."**
 - Appeared in: W24 (Q2a, 03 marks)
14. **Discuss merits and demerits of air-cooled heat exchangers over water-cooled heat exchangers.**
 - Appeared in: W24 (Q2b, 04 marks)
15. **Discuss merits and demerits of U-tube heat exchangers over floating head heat exchangers.**
 - Appeared in: W24 (Q3 OR-a, 03 marks)
16. **Discuss criteria for selection between horizontal and vertical condensers.**
 - Appeared in: W24 (Q3 OR-b, 04 marks)
17. **Discuss the process design of a kettle-type reboiler.**
 - Appeared in: W22 (Q2c, 07 marks)
18. **Discuss the stepwise design procedure for a kettle-type reboiler.**

- Appeared in: S25 (Q3c, 07 marks), W24 (Q3 OR-c, 07 marks)
- 19. **In the design of a vertical thermosyphon reboiler, the recirculation ratio is determined via trial and error... Discuss how to find or fix the recirculation ratio for conditions (i) $\Delta P_{av} \approx \Delta P_t$, (ii) $\Delta P_{av} \gg \Delta P_t$, (iii) $\Delta P_{av} \ll \Delta P_t$.**
 - Appeared in: S25 (Q3c, 07 marks), W24 (Q3c, 07 marks), S24 (Q3c, 07 marks)
- 20. **Design a 1-2 shell-and-tube heat exchanger for a given duty (Kerosene/Crude oil). Calculate tube side and shell side heat transfer coefficients.**
 - Appeared in: S22 (Q5a, 14 marks)
- 21. **A 1-2 shell and tube heat exchanger is used to cool methanol... Calculate (1) Number of tubes (2) Shell Diameter.**
 - Appeared in: W22 (Q2 OR-c, 07 marks)
- 22. **Lube-oil is to be cooled... Calculate (i) flow rate of cooling water (ii) tube side heat transfer coefficient.**
 - Appeared in: W24 (Q2c, 07 marks)
- 23. **Discuss the stepwise design procedure for a horizontal condenser.**
 - Appeared in: W24 (Q2 OR-c, 07 marks)
- 24. **Calculate the required area of a condenser for condensing Methyl Ethyl Ketone (MEK) vapour.**
 - Appeared in: S25 (Q4 OR, 07 marks)
- 25. **Consider a case where condensation is done with subcooling... Calculate the mass flow rates of cooling water...**
 - Appeared in: S23 (Q3 OR-c, 07 marks)
- 26. **Discuss the design procedure of a condenser in detail.**
 - Appeared in: W23 (Q4 OR-a, 10 marks)
- 27. **State the various types of shell and tube heat exchangers. Discuss their advantages over each other.**
 - Appeared in: W23 (Q4 OR-b, 04 marks)

Unit 3: Process Design of Distillation Column

Repeated Questions:

1. **Define: Weeping, Entrainment, and Flooding/Coning in a distillation column.**
 - Appeared in: W23 (Q1a, 03 marks), S24 (Q2a, 03 marks)
2. **Differentiate between jet flooding and downcomer flooding.**
 - Appeared in: S25 (Q1b, 04 marks), S24 (Q3a, 03 marks), W24 (Q4c, 07 marks)
3. **Discuss the criteria for selection of operating pressure in a distillation column.**
 - Appeared in: S25 (Q1c, 07 marks), W24 (Q4b, 04 marks), S23 (Q4c, 07 marks)
4. **Discuss the advantages and disadvantages of Vacuum Distillation.**
 - Appeared in: W23 (Q4b, 04 marks), W22 (Q3c, 07 marks), S24 (Q3 OR-b, 04 marks)
5. **Explain the FUG method for multicomponent distillation.**
 - Appeared in: W22 (Q3b, 04 marks)
6. **Estimate the minimum reflux ratio (R_m) and minimum number of stages (N_m) using the Underwood and Fenske equations.**
 - Appeared in: S25 (Q4, 07 marks), W24 (Q1c, 07 marks), S24 (Q4c, 07 marks)

Other Important Questions:

7. **How to fix the operating pressure in a distillation column? Explain with an example.**
 - Appeared in: W23 (Q2b, 04 marks)
8. **How does the reflux ratio affect distillation column design?**
 - Appeared in: W22 (Q3a, 03 marks)
9. **Describe the determination of the optimum reflux ratio.**
 - Appeared in: W22 (Q3 OR-b, 04 marks)
10. **Describe the effect of reflux ratio on operating, fixed cost, and total cost of a distillation column with the help of a graph.**
 - Appeared in: S25 (Q2b, 04 marks), W24 (Q4a, 04 marks)
11. **Write a short note on the selection of tray type in a tray column.**
 - Appeared in: W23 (Q4a, 03 marks)
12. **Discuss in detail the various factors considered for the selection of a tray.**
 - Appeared in: W22 (Q3 OR-a, 03 marks)
13. **Discuss the criteria for selection among the different types of trays used in a tray tower.**
 - Appeared in: S24 (Q3 OR-c, 07 marks)
14. **What is the function of a downcomer? Discuss the different types of downcomers.**
 - Appeared in: S24 (Q4a, 03 marks)
15. **Discuss the design of downcomers in a tray column.**
 - Appeared in: W23 (Q4c, 07 marks), S22 (Q3b, 04 marks)
16. **Mention the application of the Hengstebeck and Geddes equation? Discuss the equation.**
 - Appeared in: S23 (Q4a, 03 marks)
17. **Determine the number of theoretical stages required for a given separation using the FUG method.**
 - Appeared in: S22 (Q4c, 07 marks)
18. **A continuous rectifying column handles a mixture of benzene and toluene... Calculate mass flows and the number of plates required.**
 - Appeared in: W22 (Q3 OR-c, 07 marks)
19. **Discuss the design steps to calculate the number of theoretical stages in a binary distillation column.**
 - Appeared in: S22 (Q5 OR-c, 07 marks), W24 (Q4 OR-c, 07 marks)
20. **Discuss stepwise procedure to calculate tower diameter of a sieve tray distillation column.**
 - Appeared in: W24 (Q5 OR-c, 07 marks)

Unit 4: Process Design of Absorbers

Repeated Questions:

1. **Explain the function of liquid distributors, liquid re-distributors, and packing support in a packed tower absorber.**
 - Appeared in: S25 (Q5a, 03 marks), W24 (Q5a, 03 marks), S24 (Q2c, 07 marks), S23 (Q4 OR-a, 03 marks)
2. **Discuss the criteria for selection among different types of absorption equipment (Packed Tower, Spray Tower, etc.).**
 - Appeared in: S24 (Q2 OR-c, 07 marks), W22 (Q4c, 07 marks), W23 (Q3b, 04 marks)

Other Important Questions:

3. **State the various types of liquid distributors used in a packed tower. Explain any one in detail.**
 - Appeared in: W23 (Q3 OR-a, 03 marks)
4. **List the steps for the determination of the minimum amount of solvent for an absorber.**
 - Appeared in: W22 (Q4a, 03 marks)
5. **With a neat sketch, discuss any two types of random packing material used for a packed tower.**
 - Appeared in: S23 (Q4 OR-b, 04 marks), W22 (Q4b, 04 marks)
6. **Discuss in brief Random and Regular packing.**
 - Appeared in: S24 (Q4b, 04 marks)
7. **Discuss the steps for the design of a packed tower type absorber.**
 - Appeared in: W22 (Q4c, 07 marks)
8. **State the process design steps for a vertical spray tower.**
 - Appeared in: W22 (Q4 OR-b, 04 marks)
9. **Scrubber is used for absorbing acetone vapor... Calculate (a) the minimum solvent rate (b) Top diameter of the packed bed tower.**
 - Appeared in: W23 (Q3, 07 marks)
10. **Write a short note on Tinker's flow model.**
 - Appeared in: W23 (Q3 OR-c, 07 marks)
11. **Write down selection criteria for a packed tower and a spray tower.**
 - Appeared in: S23 (Q4 OR-c, 07 marks)

Unit 5: Mechanical Design of Pressure Vessel

Repeated Questions:

1. **Define: Design stress, Corrosion Allowance, and Welding Joint efficiency factor.**
 - Appeared in: W24 (Q5 OR-a, 03 marks), S23 (Q5a, 03 marks)
2. **Discuss welding joint efficiency factor.**
 - Appeared in: W22 (Q5a, 03 marks), W23 (Q5b, 04 marks)
3. **Discuss Radiography test in detail / What is Radiography? How is it carried out?**
 - Appeared in: W23 (Q5b, 04 marks), W24 (Q5 OR-b, 04 marks), S23 (Q5b, 04 marks)
4. **Discuss different types of heads (closures) for pressure vessels and their applications.**
 - Appeared in: W23 (Q5c, 07 marks), S25 (Q5b, 04 marks), S24 (Q5b, 04 marks), S22 (Q5b, 04 marks)

Other Important Questions:

5. **How to fix the design pressure (Internal and external) and design temperature for the mechanical design of a pressure vessel?**
 - Appeared in: W23 (Q5a, 03 marks)
6. **Differentiate between operating pressure and design pressure from a mechanical design perspective.**
 - Appeared in: W24 (Q5b, 04 marks)
7. **What is static and rotary equipment? Explain with examples.**
 - Appeared in: W23 (Q5 OR-a, 03 marks)
8. **Discuss the various classes of Pressure vessels.**
 - Appeared in: W23 (Q5 OR-b, 04 marks)
9. **With a neat sketch, state various types of welding joints.**
 - Appeared in: W22 (Q5b, 04 marks)
10. **Derive the equation for longitudinal and circumferential stress and discuss design stress.**
 - Appeared in: W22 (Q5c, 07 marks)
11. **Explain the selection of material of construction.**
 - Appeared in: W22 (Q5 OR-a, 03 marks), S22 (Q4a, 03 marks)
12. **Discuss the use of jackets and coils in the industry.**
 - Appeared in: W22 (Q5 OR-b, 04 marks)
13. **Discuss the design steps of a vertical cylindrical pressure vessel and head subjected to internal pressure.**
 - Appeared in: S24 (Q5c, 07 marks)
14. **Explain the graphical method to determine the thickness of a vessel subjected to external pressure with and without a stiffening ring.**
 - Appeared in: S25 (Q5c, 07 marks)
15. **A cylindrical vessel 14 ft ID and 0.3125 inch thickness... (1) Is the thickness adequate? (2) What is the allowable external pressure? (3) What is the thickness for the same ID? (4) Determine the stiffener ring requirements?**
 - Appeared in: W23 (Q5 OR-c, 07 marks)
16. **A nozzle having ID 400 mm is attached to a vessel... Calculate the weight of the reinforcement pad. / Check whether this nozzle requires a reinforcement pad or not. If required, decide its dimensions.**
 - Appeared in: S23 (Q5c, 07 marks), W22 (Q5 OR-c, 07 marks)
17. **Discuss about stress-strain curve in detail.**
 - Appeared in: S25 (Q5 OR-b, 04 marks)
18. **Discuss about five standard types of pressure taps for orifice meter. State advantages and disadvantages of orifice meter over venturi meter.**
 - Appeared in: W24 (Q5c, 07 marks)
