GUJARAT TECHNOLOGICAL UNIVERSITY

BE-5 SEMESTER – OLD PAPER – W22 TO S25 – QUESTION BANK

Subject Name & Code:

Chemical Process Plant Design & Economics- 3150506

Unit 1: Introduction and Process Design Aspects

Repeated Questions:

1. **What is the role of a chemical engineer in a chemical process industry?**
   - WINTER 2024 (03 Marks)
   - SUMMER 2023 (03 Marks)
   - WINTER 2022 (03 Marks)
2. **State and discuss the factors to be considered in the selection of the location of a chemical plant.**
   - WINTER 2024 (07 Marks)
   - SUMMER 2023 (07 Marks)
   - SUMMER 2024 (07 Marks)
   - WINTER 2022 (07 Marks)
3. **Discuss types of flow diagrams in brief. / Write in brief on different types of flow diagrams.**
   - SUMMER 2024 (07 Marks)
   - SUMMER 2022 (04 Marks)
   - WINTER 2023 (03 Marks)
   - SUMMER 2025 (03 Marks)
4. **Differentiate between batch and continuous process. / Write in brief on continuous process v/s batch process.**
   - SUMMER 2024 (04 Marks)
   - WINTER 2023 (03 Marks)
   - SUMMER 2025 (03 Marks)

Other Important Questions:

5. Explain in detail about chemical plant design. (WINTER 2024, 07 Marks)
6. What is a Pilot Plant? State the objectives and importance of a pilot plant. (WINTER 2024, 07 Marks)
7. List all points in a feasibility survey. Explain ‘Markets’ & ‘Properties of products’ with respect to the same. (WINTER 2024, 07 Marks; SUMMER 2024, 07 Marks; WINTER 2022, 07 Marks)
8. Explain about Scale Models. (SUMMER 2024, 03 Marks)
9. How is preliminary and techno-economical feasibility of any project carried out? (SUMMER 2022, 07 Marks)
10. Justify the various factors to be considered in the location of a dye and dye intermediate manufacturing industry in Gujarat. (WINTER 2023, 07 Marks)
11. What are the various stages of process development of a chemical plant? (SUMMER 2025, 04 Marks)

Unit 2: Selection of Process Equipments

Repeated Questions:

1. **Distinguish between standard v/s special equipment. / Differentiate between Standard and Special equipment.**
    - WINTER 2024 (04 Marks)
    - SUMMER 2024 (04 Marks)
    - WINTER 2022 (04 Marks)
    - WINTER 2023 (04 Marks)
    - SUMMER 2025 (04 Marks)

Other Important Questions:

2. What is standard equipment? State the advantages of standard equipment over special equipment. (SUMMER 2023, 03 Marks)
3. Discuss advantages of standard equipment over special equipment. (SUMMER 2022, 03 Marks)
4. Discuss selection of size reduction equipment. (WINTER 2022, 03 Marks)
5. Discuss selection criteria of material handling equipment. (WINTER 2023, 03 Marks; SUMMER 2022, 04 Marks)
6. Draw a specification sheet for a Heat Exchanger. (WINTER 2024, 03 Marks)
7. How is a specification sheet for a heat exchanger prepared? (SUMMER 2022, 04 Marks)
8. Outline the list of preliminary specifications needed to be specified for equipment in a specification sheet. (SUMMER 2025, 07 Marks)
9. List preliminary specifications for equipment in general. (WINTER 2022, 04 Marks)

Unit 3: Process Auxiliaries and Process Utilities

Repeated Questions:

1. **Write briefly on overhead v/s underground piping.**
    - WINTER 2024 (04 Marks)
    - SUMMER 2024 (03 Marks)
    - WINTER 2023 (04 Marks)
    - SUMMER 2022 (03 Marks)

Other Important Questions:

2. **Numerical on Insulation Thickness Optimization:** The fixed cost of a steam line for a circular pipe is expressed as: (35x+65) Rs./hr. The cost of loss of heat from the pipe is given as: (225/x) Rs./hr. Where x is the thickness of insulation in cm. Determine the optimum value of thickness and also calculate the total cost of the pipe per meter for optimum thickness. (WINTER 2024, 07 Marks; SUMMER 2024, 07 Marks)
3. List out six important requirements for piping layout. (SUMMER 2024, 03 Marks; WINTER 2023, 03 Marks)
4. Discuss on piping design and its layout used in the chemical industry. (SUMMER 2022, 07 Marks)
5. Discuss the principle of Piping Design. (WINTER 2023, 07 Marks)
6. Write a short note on pipe fittings. (SUMMER 2025, 03 Marks)
7. Discuss with rough sketches different types of pipe fittings with specific uses. (WINTER 2022, 07 Marks)
8. Discuss selection criteria of valves in brief. (WINTER 2022, 04 Marks)
9. Discuss the selection criteria of valves. Name commonly used pipe fittings and valves with their main functions. (WINTER 2023, 07 Marks)
10. Write in brief the importance of utilities in chemical industries. (WINTER 2023, 07 Marks; SUMMER 2025, 03 Marks)
11. Discuss the principles of various treatment methods for boiler-feed water in a chemical industry. (SUMMER 2023, 07 Marks)
12. Discuss various waste treatment and disposal methods. (WINTER 2022, 07 Marks)
13. Explain process control and instrumentation control system design. (From Unit 3 Syllabus)
14. Discuss typical gaseous pollutants and their sources. (WINTER 2022, 04 Marks)

Unit 4: Plant Location and Layout

Repeated Questions:

1. **Sketch an ideal plant layout.**
    - WINTER 2024 (03 Marks)
    - SUMMER 2023 (07 Marks)
    - SUMMER 2025 (04 Marks)

Other Important Questions:

2. List and discuss the principles of plant layout. (SUMMER 2025, 07 Marks)
3. Write a brief note on the 'Unit area concept'. (WINTER 2024, 04 Marks; SUMMER 2023, 04 Marks; WINTER 2022, 03 Marks)
4. Draw a typical master plot plan of an industry. (SUMMER 2024, 03 Marks; WINTER 2022, 03 Marks)
5. Write in brief on factors to be considered in an efficient plant layout. (SUMMER 2022, 04 Marks)
6. What are the advantages and disadvantages of vertical and horizontal layouts? (WINTER 2022, 07 Marks)
7. Define/explain: (i) Battery limit (ii) Grass Root Plant. (SUMMER 2022, 03 Marks; SUMMER 2024, 04 Marks; WINTER 2022, 04 Marks)

Unit 5: Cost Estimation

Repeated Questions:

1. **Numerical on Cost Index and Scale-up (Six-tenths factor rule):** A heat exchanger of Area A1 costed Rs. C1 in Year1. What is the estimated cost of Area A2 in Year2? (Given cost indices and scale-up exponent).
    - **WINTER 2024 (03 Marks):** 10 m² @ ₹50,000 (2019, CI=270) to 15 m² (2024, CI=320), exponent=0.6.
    - **SUMMER 2023 (03 Marks):** 10 m² @ ₹50,000 (2017, CI=270) to 15 m² (2022, CI=320), exponent=0.6.
    - **SUMMER 2022 (07 Marks):** 10 m² @ ₹150,000 (2014, CI=320) to 15 m² (2021, CI=450), exponent=0.6.
    - **SUMMER 2025 (07 Marks):** 25 m² @ ₹50,00,000 (2020, CI=600) to 50 m² (2023, CI=800), exponent=0.58.
    - **SUMMER 2024 (03 Marks):** Refinery capacity cost estimation.
2. **Draw a tree-diagram to show the cash flow for an industrial operation. / Explain cash flow for industrial operation by drawing tree diagram.**
    - WINTER 2024 (07 Marks)
    - SUMMER 2023 (04 Marks)
    - SUMMER 2025 (07 Marks)
3. **Explain fixed and working capital investment.**
    - WINTER 2023 (04 Marks)
    - SUMMER 2022 (03 Marks - "What is capital investment?")

Other Important Questions:

4. **Numerical on Turnover Ratio:** The total investment for a chemical plant is ₹X million and the working capital is ₹Y million. If the plant produces Z kg/day for 365 days, what selling price per kg gives a turnover ratio of 1.0?
    - WINTER 2024 (07 Marks): ₹50M & ₹5M, 8000 kg/day.
    - SUMMER 2022 (07 Marks): ₹100M & ₹10M, 8000 kg/day.
    - SUMMER 2024 (04 Marks): ₹50M & ₹5M, 8000 kg/day.
5. State methods of estimating capital Investment. Discuss any one in detail. (SUMMER 2025, 04 Marks)
6. Discuss six-tenth factor rule. (SUMMER 2023, 03 Marks; SUMMER 2025, 03 Marks)
7. Discuss with figure, cumulative cash position for an industrial operation neglecting time value of money. (WINTER 2023, 04 Marks)
8. List out factors affecting investment and production cost. (SUMMER 2022, 07 Marks)
9. List out costs involved in Direct and Indirect Cost. (SUMMER 2024, 04 Marks; WINTER 2022, 04 Marks)
10. Explain cost indices in chemical engineering cost estimation. Explain how will you use the index method. (SUMMER 2022, 04 Marks)
11. Explain following cost index: (i) Marshall and Swift (ii) Chemical Engineering Plant Cost Index. (WINTER 2024, 04 Marks)
12. Explain Nelson Farrar Refinery construction cost index. (SUMMER 2023, 03 Marks)
13. It is desired to borrow ₹1000... Calculate compound interest, nominal and effective interest rate. (SUMMER 2025, 04 Marks) *[Simple/Compound Interest Topic]*

Unit 6: Estimation of Total Product Cost

Repeated Questions:

1. **Explain Break-even analysis (with chart/definition) and perform calculation.**
    - **WINTER 2024 (03 Marks):** Definition & Numerical: Selling price ₹120/kg, Cost ₹80/kg, Fixed cost ₹12,00,000. Find BEP in kg.
    - **SUMMER 2024 (03 Marks):** Same numerical as above.
    - **WINTER 2024 (03 Marks - OR):** Using diagram explain break-even point.
    - **SUMMER 2024 (03 Marks - OR):** Using diagram explain break-even point.
    - **SUMMER 2022 (03 Marks - OR):** Using diagram explain break-even point.
    - **WINTER 2023 (03 Marks):** Explain break-even point with a diagram.
    - **SUMMER 2025 (07 Marks):** Complex numerical involving gross earnings and net profit.

Other Important Questions:

2. Write a short note on plant overhead costs. (WINTER 2022, 03 Marks; SUMMER 2025, 03 Marks)
3. State various factors affecting investment and total product cost? (WINTER 2024, 04 Marks)
4. Enlist the factors to be considered on total product cost estimation. (WINTER 2023, 07 Marks)
5. **Numerical on Complex Break-even and Profitability:** The annual direct production cost... What is the breakeven point? What were the annual gross earnings and net profit? (SUMMER 2022, 07 Marks)
6. **Numerical on Break-even:** The annual production of a plant is ₹36.4 lakhs... find BEP. (SUMMER 2025, 04 Marks)

Unit 7: Depreciation

Repeated Questions:

1. **Define: (1) Salvage value (2) Book value (3) Market Value.**
    - WINTER 2024 (03 Marks)
    - SUMMER 2023 (03 Marks)
    - SUMMER 2024 (03 Marks)
    - WINTER 2022 (03 Marks)
2. **Numerical on Depreciation Calculation:** The original value of equipment is ₹X, salvage value ₹Y, life N years. Find book value at the end of Z years using:
    - **Straight Line Method (SLM) & Declining Balance Method (DBM):**
        - WINTER 2024 (07 Marks): Heat Exchanger, ₹6 lacs, Salvage ₹60,000, 10 years, BV at 5 years (SLM & DBM).
        - SUMMER 2023 (07 Marks): Equipment, $22,000, Salvage $2,000, 10 years, BV at 5 years (SLM & DBM).
        - SUMMER 2025 (07 Marks): Reactor, ₹4,00,00,000, BV at 5 years (SLM & DBM).
    - **SLM & Sum of Years Digit (SOYD) Method:**
        - SUMMER 2024 (07 Marks): Heat Exchanger, ₹6 lacs, Salvage ₹50,000, 10 years, BV at 5 years (SLM & SOYD).
    - **SLM, Textbook DBM & Double DBM:**
        - SUMMER 2022 (07 Marks): Cyclone Separator, ₹32,000, Salvage ₹2,000, 7 years, BV at 5 years.
3. **List methods for determining depreciation. Explain any one in detail.**
    - WINTER 2024 (04 Marks)
    - SUMMER 2024 (04 Marks)

Other Important Questions:

4. Define depreciation. List six methods for determining depreciation. (WINTER 2023, 03 Marks)
5. Discuss types of depreciation in brief. (SUMMER 2023, 04 Marks; WINTER 2022, 04 Marks)
6. Explain about (i) physical depreciation and (ii) functional depreciation. (WINTER 2024, 04 Marks)
7. Define: ... Functional depreciation. (SUMMER 2022, 03 Marks)
8. **Numerical on Sinking Fund Method:** The original cost... Determine the asset value using the sinking fund method. (WINTER 2022, 07 Marks)
9. **Numerical on Annuity for Replacement:** The original value... How much must be placed annually to replace the equipment? (WINTER 2023, 07 Marks)

Unit 8: Profitability, Alternative Investments and Replacement

Repeated Questions:

1. **Discuss replacement studies with an example.**
   - WINTER 2024 (03 Marks)
   - SUMMER 2023 (04 Marks)
2. **Discuss various practical factors of alternative investment and replacement decision.**
   - WINTER 2023 (04 Marks)
   - SUMMER 2024 (07 Marks)
3. **Enlist various methods of Profitability Analysis. Explain any one/two in detail.**
   - SUMMER 2023 (04 Marks)
   - SUMMER 2025 (07 Marks)

Other Important Questions:

4. **Define: (i) payback period (ii) net present worth (iii) rate of return on investment. / Define/explain: (i) Payout period (ii) ROI.**
   - SUMMER 2023 (03 Marks)
   - WINTER 2023 (03 Marks)
5. **Explain: (1) Rate of return (2) Payback period.**
   - SUMMER 2024 (04 Marks)
   - WINTER 2022 (04 Marks)
6. **Numerical on Alternative Investment Decision (Heat Exchanger Case Study):** Four different heat exchangers have been designed... Only one can be accepted. Which design should be recommended? (SUMMER 2024, 07 Marks) *[A very important numerical problem]*
7. **Numerical on Machine Replacement Decision:** Machine A costs Rs.92,500 (life 4 yrs). Machine B costs Rs.1,35,000 (life 7 yrs). Cost of capital is 15%. Which machine should be selected? (WINTER 2022, 07 Marks)
8. **Numerical on Pump Replacement for Common Life:** Two pumps... If the annual cost of capital recovery is the same for both, determine the common life. (SUMMER 2022, 04 Marks; SUMMER 2025, 07 Marks)
9. **Numerical on Capitalized Cost:** A distillation column cost ₹10,00,000, life 15 years, scrap ₹30,000. Calculate capitalized cost at 5% interest. (SUMMER 2025, 04 Marks)
10. **Numerical on Optimization of Total Cost:** The effect of variable x,y on total cost $C_T = 2.33x + \frac{11900}{xy} + 1.86y + 100$. Determine value of x and y for least cost. (SUMMER 2025, 07 Marks) *[A classic optimization problem]*

Unit 9: Project Management

Repeated Questions:

1. **Write short note on CPM and PERT. / Compare CPM and PERT techniques.**
    - WINTER 2024 (07 Marks)
    - SUMMER 2023 (07 Marks)
    - WINTER 2023 (07 Marks)
    - SUMMER 2024 (07 Marks)
2. **Discuss planning of project schedule by 'BAR CHART' in detail. / What is BAR chart? Explain planning of a project schedule using it.**
    - WINTER 2024 (04 Marks)
    - SUMMER 2023 (07 Marks)

Other Important Questions:

3. **Numerical on Drawing Network Diagram and Finding Critical Path:** Activities with predecessors and times are given. Draw the network and find the critical path and project completion time.
    - WINTER 2023 (07 Marks)
    - SUMMER 2022 (07 Marks)
    - SUMMER 2025 (07 Marks - R&D Project)
4. **Draw a Bar Chart for the given activities and find project completion time.** (WINTER 2023, 07 Marks)
5. Write a brief note on PERT techniques used for Inventory control. (WINTER 2023, 04 Marks; SUMMER 2025, 03 Marks)

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