Ahmedabad University
School of Engineering and Applied Science
2025-2026 Monsoon Semester

CHE440 Process Design and Economics
End Term Examination
Monday 1st December, 11 AM-01 PM

Name	*Roll No*	*A*	*U*								*Marks* __/50

Write your answers in the answer book. Attach this sheet to the answer book and then submit it. Answer all questions. The formula sheet is attached with the question paper.

Section A (answer all, write the correct answer in the answer book) 1×10 =10

1. The Return on Investment (ROI) is defined as:

a) Net annual profit before tax / Working capital

b) Net annual profit after tax / (Fixed + Working capital) *(1)*

c) Gross profit / Total capital investment

d) Total manufacturing cost / Gross sales

2. The six-tenths factor rule is used primarily for:

a) Estimating piping cost

b) Updating cost indices *(1)*

c) Estimating equipment cost based on capacity

d) Estimating building cost

3. In the breakeven section, depreciation is classified as:

a) Direct expense

b) Indirect expense *(1)*

c) Utility expense

d) Raw material expense

4. According to the document, insulation cost in typical chemical plants is approximately:

a) 2–4% of purchased equipment cost

b) 5–6% of purchased equipment cost *(1)*

c) 8–9% of purchased equipment cost

d) 12–15% of purchased equipment cost

5. The cost index used for adjusting past equipment costs to present value includes:

a) Lang factor index

b) Reynolds number index *(1)*

c) Marshall and Swift Index

d) Mach number index

6. A machine costs ₹40,000, has a salvage value of ₹5,000, and a service life of 5 years. What is the annual depreciation using the straight-line method? *(1)*

a) ₹5,000

b) ₹7,000

c) ₹7,000

d) ₹8,000

7. A machine costs ₹20,000 and uses a fixed percentage factor of 20% (declining-balance). What is the book value after 2 years?

a) ₹16,000

b) ₹14,000 *(1)*

c) ₹12,800

d) ₹10,240

8. A factory has an assessed property value of ₹50,00,000. If the local property tax rate is 2%, what is the annual tax?

a) ₹50,000

b) ₹1,00,000 *(1)*

c) ₹1,00,000

d) ₹2,00,000

9. If a company's capital investment is ₹8 crore, and the typical insurance cost is 1% per year, what is the annual insurance expense?

a) ₹4,00,000

b) ₹8,00,000 *(1)*

c) ₹80,000

d) ₹12,00,000

10. Which type of insurance protects a company from loss of income when operations stop due to events like fire or emergencies?

a) Public-liability insurance

b) Fire insurance *(1)*

c) Business-interruption insurance

d) Marine and transportation insurance

Section B (Answer any 16 questions for this section) 2.5×16 = 40

1. An investor places ₹10,000 in a scheme paying 5% per year compounded quarterly. What is the value after 3 years? *(2.5)*

2. A credit product quotes a nominal rate of 18% per year compounded monthly. Calculate the effective annual interest rate. *(2.5)*

3. A heat exchanger with basic price ₹2,00,000 depreciates at 8% per year. What is its price after 5 years? *(2.5)*

4. A heat exchanger with a capacity of 50 m^2 cost ₹8,00,000 when purchased. You need a new exchanger of 250 m^2. Estimate the cost of the new unit using the six-tenths rule. *(2.5)*

5. Explain the purpose of cost indices and name any two indices used in chemical engineering cost estimation. *(2.5)*

6. An amount of INR 5,000 is invested at 3% compounded monthly for 2 years. Find the future value. *(2.5)*

7. A company borrows INR 50,000 for 75 days at 8% simple interest. The lender gives two options: Option A: Ordinary interest (360-day year), Option B: Exact interest (365-day year) Which option results in lower interest? Show the calculations. *(2.5)*

8. A student wants to invest INR 20,000 for 3 years. Two banks offer: Bank A: 6% simple interest annually, Bank B: 6% interest compounded quarterly Which bank gives a higher maturity amount? *(2.5)*

9. Rohit takes a 10-year loan of INR 3,00,000 at 12% nominal annual interest, repaid in equal monthly installments. Explain how the interest and principal portions of each instalment change over time, and why. *(2.5)*

10. A company purchases equipment for ₹60,000, expects it to last 8 years with a salvage value of ₹4,000. After 3 years, the company discovers the machine will only last 2 more years with a salvage value of ₹2,000. Compute the new annual depreciation for the remaining 2 years. *(2.5)*

11. A company has: Total income = ₹80 lakh, Total product cost = ₹65 lakh. Calculate its gross earnings and income tax payable if the state tax rate is 5%. *(2.5)*

12. A company buys a high-tech machine that becomes obsolete quickly. Which depreciation method should it prefer, straight-line or declining-balance, and why? *(2.5)*

13. A company stores expensive raw materials onsite. Explain why business-interruption insurance and fire insurance are essential. *(2.5)*

14. A chemical plant built in 2010 cost ₹50 crore. You want to build a similar plant in 2025. Cost indices: CEPCI 2010 = 550, CEPCI 2025 = 820. Estimate the new fixed capital cost. *(2.5)*

15. A company finds a new process that requires ₹12 crore (fixed + working capital). Expected net annual profit after tax = ₹1.8 crore. ROI must be ≥ 15% to accept a project. Should the company invest? *(2.5)*

16. A researcher takes a 5-year loan of ₹3,00,000 at 11% annual interest, repaid monthly. She wants to know whether her first month's instalments will be mostly interest or principal. Help her to take decision. *(2.5)*

17. A company installs high-tech robotics for ₹80 lakh. Due to rapid technological change, the equipment loses value quickly in the first few years. Which depreciation method should be used? *(2.5)*

18. A chemical company stores flammable solvents and worries about fires and shutdowns. Which two insurances are essential? *(2.5)*

19. A plant buys equipment for ₹90,00,000 with a life of 9 years and salvage ₹9,00,000. After 3 years, it is found that the remaining life is only 3 years. Find the new annual depreciation. *(2.5)*

20. A chemical manufacturer pays excise tax of 7% on product sales. If annual sales equal ₹120 crore, and product cost is ₹90 crore, determine tax paid and net earnings after excise tax. *(2.5)*

Annual depreciation: Value after years: Straight-Line Depreciation: Declining-Balance Depreciation: V_a	Simple Interest: Ordinary simple interest: Exact simple interest: Compound Interest: Compound amount: effective annual interest rate:
Six-Tenths Rule Formula Where (six-tenths rule).	Six-Tenths Rule and Error Calculation (cost ratio = R) Six-tenths estimate: Actual exponent: Percentage error:
	Cost Index Purpose

End of question paper