

IV B.Tech. I Semester Regular Examinations, November -2005
CHEMICAL ENGINEERING PLANT DESIGN & ECONOMICS
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. Ethylene is produced commercially in a variety of different process. Feed stocks for these various processes range from refinery gas, Ethane, Propane, butane, natural gasoline, light and heavy naphthas to gas and oil and heavier fractions. Make a preliminary material balance for the production of 50 million kg/year of ethylene. Assume an operating factor of 90. [16]
2. Discuss about the sources of exposure to health hazards and exposure-hazard control in a chemical plant. [16]
3. (a) What is six-tenths-factor rule? Where is it used? [6]
(b) The purchased and installation costs of some pieces of equipment are given as a function of weight rather than capacity. An example of this is the installed costs of large tanks. The 1980 cost for an installed aluminum tank weighing 100 kg was Rs. 3,90,000. For a size range from 200 to 1000 kg, the installed cost-weight exponent for aluminum tanks is 0.93. If an aluminum tank weighing 700 kg is required, what is the present capital investment needed? [10]
4. (a) Write short notes on various types of interests. [8]
(b) What are annuities? Explain various annuities. [8]
5. Write short notes on
(a) Exercise Taxes. [3x3=9]
Property Taxes.
Income Tax Return.
(b) What are tax exemptions usually available to manufacturing companies? Discuss them in detail. [7]
6. (a) What is sinking fund method for the determination of depreciation? [4]
(b) Derive an equation for asset value of equipment after few years of use by the application of sinking fund method. [6]
(c) Compare sinking fund method with straight-line method. [6]
7. Discuss briefly the methods of selecting alternates. Calculate from the data given which machine A or B is more economical Money is worth 8 percent per year: [16]

	A	B
Intial Cost	Rs. 9,696	Rs. 25,000
Salvage value	Rs. 500	Rs. 1,500
Uniform end of year expenses	Rs. 3,000	Rs. 2,000
Service Life	2	5

8. The following equation shows the effect of the variables 'X' and 'V' on the total cost for a particular operation:

$$C_T = 2.33 X + 12000/XV + 1.92 V + 10$$

Determine the value of X and V which will give the least total. [16]

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1. Explain in detail how to obtain the design information before starting a plant. [16]
2. (a) Give an outline of the accounting procedure with the help of a schematic diagram. [8]
(b) Explain the following: [8]
 - i. Balance sheet .
 - ii. Income statement.
3. Write about the following with regard to estimation of total product cost
 - (a) Fixed charges. [8]
 - (b) Plant overheads. [8]
4. (a) Derive the expression for capitalized cost for continuous interest compounding. [6]
(b) A standard type of heat exchanger with a negligible scrap value costs Rs. 4000 and will have a useful life of 6 years. Another proposed heat exchanger of equivalent design capacity costs Rs. 6800 but will have a useful life of 10 years and a scrap value of Rs. 800. Assuming an effective compound interest rate of 8 percent per year, determine which heat exchanger is cheaper by comparing the capitalized costs. [10]
5. Self Insurance is being considered for one portion of a chemical company. The fixed-capital investment involved is \$ 50,000, and insurance costs for complete protection would amount to \$ 400 per year. If Self Insurance is used, a reserve fund will be set up under the company's jurisdiction, and annual insurance premiums of \$ 300 will be deposited in this fund under an ordinary annuity plan. All money in the fund can be assumed to earn interest at a compound annual rate of 5 %. Neglecting any connected with administration of the fund, how much money should be deposited in the fund at the beginning of the program in order to have enough money accumulated to replace a complete \$ 50,000 loss after 10 years ? [16]
6. (a) Derive an equation to determine annual depreciation by the sum of years digits method. [8]
(b) An equipment having a negligible salvage value is estimated to have a service life of 10 years. The original cost of the equipment is Rs. 4,00,000. Determine the percent of the original investment paid off in the first half of service life using the sum of year's digits method. [8]

7. Discuss Rate of return based on the discounted cash flow with a suitable example.

[16]

8. Write the procedure for the optimum design with two or more variables. Explain both graphical and analytical procedures.

[16]

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1. Synthesis gas may be prepared by a continuous, non catalytic conversion of any hydrocarbon by means of controlled partial combustion in a fire-bride lined reactor. The hydrocarbon and oxidant (oxygen or air) are separately pre heated and charged to the reactor. Before entering the reaction zone the tow feed stocks are intimately mixed in a combustion chamber. The heat produced by combustion part of the hydrocarbon pyrolyzes remaining hydrocarbons into gas and a small amount of carbon in reaction zone. The reactor efficient then passes through a waste heat boiler, a water-wash carbon-removal unit, and a water cooler-scrubber. Carbon is recovered in equipment of simple design in a firm which can be used as fuel or in ordinary carbon products. Prepare a simplified equipment flow sheet in the process, with temperatures-and pressure. [16]
2. Give an account of materials handling, storage, structural design and utilities in the design of a chemical process plant. [16]
3. (a) Write a brief note about different types of cost indexes. [10]
(b) Discuss about the cost of purchased equipment being one of the factors in estimating fixed capital investment. [6]
4. (a) Write short notes on costs due to interest on investment and source of capital. [8]
(b) Explain briefly perpetuities and capitalized costs. [8]
5. Write short notes on
(a) Exercise Taxes. [3x3=9]
Property Taxes.
Income Tax Return.
(b) What are tax exemptions usually available to manufacturing companies? Discuss them in detail. [7]
6. (a) The initial installed cost for an equipment is Rs 1,00,000 and its scrap value at the end of useful life of 10 years is Rs 20,000. After the equipment has been in use for 4 years, it is sold for Rs 70,000. Straight-line method is employed to determine depreciation cost and the asset value for the equipment at the end of 4 years is found to be Rs 52,400. The total income tax rate is 34 % of all gross earnings. Capital gain taxes amount to 34% of the gain. How much net saving after taxes would have been there if declining balance method was used instead of straight-line depreciation method?. [12]

- (b) Differentiate between book value and market value. [4]
7. Explain the following
- (a) Present worth. [5]
- (b) Capitalised costs. [5]
- (c) Payout period. [6]
8. Write the procedure for the optimum design with two or more variables. Explain both graphical and analytical procedures. [16]

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1. Ethylene is produced commercially in a variety of different process. Feed stocks for these various processes range from refinery gas, Ethane, Propane, butane, natural gasoline, light and heavy naphthas to gas and oil and heavier fractions. Prepare three different qualitative flow sheets to handle a majority of these feed stocks. What are the advantages and disadvantages of each selected process? [16]
2. Write short notes on: [4x4=16]
 - (a) Development of a pollution control system.
 - (b) Solid waste disposal.
 - (c) Thermal pollution control.
 - (d) Chemical treatment of wastewaters.
3. Write in detail about the following methods for estimating capital investment
 - (a) Detailed-item estimate. [4]
 - (b) Unit-cost estimate. [6]
 - (c) Percentage of delivered-equipment cost. [6]
4. (a) Derive the expression for capitalized cost for the case of discrete interest compounding. [6]
(b) A reactor, which will contain corrosive liquids has been designed. If the reactor is made of mild steel, the initial installed cost will be Rs. 5000, and the useful-life period will be 3 years. Since stainless steel is highly resistant to the corrosive action of the liquids, stainless steel, as the material of construction, has been proposed as an alternative to mild steel. The stainless steel reactor, would have an initial installed cost of Rs. 15,000. The scrap value at the end of the useful life would be zero for either type of reactor, and both could be replaced at a cost equal to the original price. On the basis of equal capitalized costs for both types of reactors, what should be the useful life period for the stainless steel reactor if money is worth 6% compounded annually? [10]
5. (a) What do you understand by negative taxable income? How is it used in the calculation of income tax? Explain. [8]
(b) Define the term 'excess profit tax'. When and why is it levied? Discuss it in detail. [8]
6. (a) What is sinking fund method for the determination of depreciation? [4]

- (b) Derive an equation for asset value of equipment after few years of use by the application of sinking fund method. [6]
- (c) Compare sinking fund method with straight-line method. [6]
- 7. Explain the following
 - (a) Present worth. [5]
 - (b) Capitalised costs. [5]
 - (c) Payout period. [6]
- 8. Give a brief summary of analytical techniques with lagrange multipliers. [16]

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