Code No: M0822 /R07 **Set No. 1**

IV B.Tech. I Semester Regular Examinations, November 2010
CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS
(Chemical Engineering)

Time: 3 Hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Explain the different steps involved in the development of a process design.
   (b) Describe the various types of flow diagrams. [10+6]

2. (a) Write about factors effecting investment and production costs.
   (b) What are the different types of capital cost estimates? Explain briefly. [10+6]

3. (a) Write about the various forms of compartmentalization for presenting capital investment estimates.
   (b) Give a brief account of the fixed charges and plant overhead costs in estimating total product cost. [8+8]

4. (a) Derive the expression for the relation between amount of ordinary annuity and periodic payments for the case of discrete cash flow and interest compounding, and also for the case of continuous cash flow and interest compounding.
   (b) An annuity due is being used to accumulate money. Interest is compounded at an effective annual rate of 8% and Rs. 1000 is deposited at the beginning of each year. What will the total amount of the annuity due be after 5 years? [8+8]

5. (a) Discuss briefly about property taxes, excise taxes, income taxes, normal tax and surtax.
   (b) Discuss about self-insurance in detail. [10+6]

6. (a) Explain sum-of-years-digits method and sinking fund method for determining depreciation.
   (b) The original value of a piece of equipment is Rs. 22,000, completely installed and ready for use. Its salvage value is estimated to be Rs. 2000 at the end of a service life estimated to be 10 years. Determine the asset value of the equipment at the end of 5 years using (i) Straight-line method, (ii) Text book declining-balance method and (iii) Double-declining balance method. [6+10]

7. (a) Write about payout period for profitability analysis [6+10]
   (b) A proposed chemical plant will require a fixed-capital investment of Rs. 10,00,000. It is estimated that the working capital will amount to 25% of the total investment and annual depreciation costs are estimated to be 10% of the fixed-capital investment. If the annual profit will be Rs. 3,00,000, determine the standard percent return on the total investment and the minimum payout period.

8. Describe the general procedure for determining optimum conditions, both analytical and graphical procedures, with one variable and with two or more variables. Give a comparison of graphical and analytical methods. [16]

Code No: M0822 /R07 **Set No. 2**

IV B.Tech. I Semester Regular Examinations, November 2010
CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS
(Chemical Engineering)

Time: 3 Hours **Max Marks:80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the various factors to be considered for a proper pant layout? Why is it important to have a proper plant layout?
   (b) Discuss the various methods of preparation of plant layout. [10+6]

2. (a) Define cost index. Explain different types of cost indexes.
   (b) Write about the detailed-item estimate method and unit-cost estimate method for estimating capital investment. [8+8]

3. Give a detailed account of the direct production costs involved in the estimation of total product cost. [16]

4. (a) What is an annuity? Obtain the relation between amount of ordinary annuity and periodic payment for discrete cash flow and interest compounding.
   (b) A piece of equipment has an initial installed value of Rs. 12,000. It is estimated that its useful life period will be 10 years and its scrap value at the end of the useful life will be Rs. 2000. The depreciation will be charged as a cost by making equal charges each year, the first payment being made at the end of the first year. The depreciation fund will be accumulated at an annual interest rate of 6%. At the end of the life period, enough money must have been accumulated to account for the decrease in equipment value. Determine the yearly cost due to depreciation under these conditions. [8+8]

5. (a) Explain carry-back and carry-forward of losses, capital gains tax and excess profits tax.
   (b) Write about the legal responsibilities of a concern with regard to accidents or other emergencies. [6+10]

6. (a) Distinguish between book value, market value and replacement value.
   (b) The original investment for an asset was Rs. 10,000, and the asset was assumed to have a service life of 12 years with Rs. 2000 salvage value at the end of the service life. After the asset has been in use for 5 years, the remaining service life and final salvage value are re-estimated at 10 years and Rs. 1000, respectively. Under these conditions what is the depreciation cost during the sixth year of the total life if straight-line depreciation is used. [6+10]

7. (a) Explain rate of return on investment for profitability analysis
   (b) An investigation of a proposed investment has been made. The following result has been presented to management: The minimum payout period based on capital recovery using a minimum annual return of 10% as a fictitious expense is 10 years; annual depreciation costs amount to 8% of the total investment. Using this information, determine the standard rate of return on the investment. [6+10]

8. Discuss about optimum production rates from an analysis of costs involved and thereby obtain expressions for optimum production rate for minimum cost for unit of production and for maximum total profit per unit of time. [16]

Code No: M0822 /R07 **Set No. 3**

IV B.Tech. I Semester Regular Examinations, November 2010
CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS
(Chemical Engineering)

Time: 3 Hours **Max Marks:80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) What are the factors to be considered during the feasibility survey of the process design.
   (b) Describe the various types of design. [10+6]

2. (a) Discuss cash flow for industrial operations with the help of a neat diagram.
   (b) Write briefly about fixed capital investment and working capital. [10+6]

3. Discuss about a) the general expenses and b) the fixed charges involved in estimation of total product cost. [10+6]

4. (a) Explain perpetuities and capitalized cost with an example. Derive the expression for capitalized cost. [8+8]
   (b) A new piece of completely installed equipment costs Rs. 12,000 and will have a scrap value of Rs. 2000 at the end of its useful life. If the useful-life period is 10 years and the interest is compounded at 6% per year, what is the capitalized cost of the equipment?

5. (a) Explain normal tax, surtax, capital gains tax and excess profits tax. [8+8]
   (b) Write about the major insurance requirements for manufacturing concerns.

6. (a) Explain the straight-line method and declining balance method for determining depreciation.
   (b) The initial cost of the completely installed reactor is Rs. 60,000, and the salvage value at the end of the useful life is estimated to be Rs. 10,000. Excluding depreciation costs for the reactor, the total annual expenses for the plant are Rs. 100,000. How many years of useful life should be estimated for the reactor if 12% of the total annual expenses for the plant are due to the cost for reactor depreciation? The straight-line method for determining depreciation should be used. [8+8]

7. A heat exchanger has been designed and insulation is being considered for the unit. The insulation can be obtained in thickness of 1, 2, 3, or 4 in. The following data have been determined for the different insulation thicknesses:

	1 in.	2 in.	3 in.	4 in.
Btu/h saved	300,000	350,000	370,000	380,000
Cost for installed insulation	Rs. 1200	Rs. 1600	Rs. 1800	Rs. 1870
Annual fixed charges	10%	10%	10%	10%

What thickness of insulation should be used? The value of heat is 30 paise / 1,000,000 Btu. An annual return of 15% on the fixed-capital investment is required for any capital put into this type of investment. The exchanger operates 300 days per year. [16]

8. (a) Illustrate the principles of an optimum economic design by determining the optimum thickness of insulation for a given steam pipe installation.
   (b) Discuss about the intangible and practical considerations in optimum design.
   (c) Discuss about the break-even chart for production schedule and its significance for optimum analysis. [6+4+6]

Code No: M0822/R07 **Set No. 4**

IV B.Tech. I Semester Regular Examinations, November 2010
CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS
(Chemical Engineering)

Time: 3 Hours **Max Marks:80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Discuss the important factors to be considered in selecting a location for a chemical process plant. [16]

2. Write briefly about the various cost factors in capital investment. [16]

3. Enlist the costs involved in total product cost for a typical chemical process plant [16]

4. (a) What is present worth of an annuity? Derive the expression for the present worth of an annuity for the case of discrete interest compounding.
   (b) A heat exchanger has been designed for use in a chemical process. 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 and costs Rs. 6800 but will have a useful life of 10years and a scrap value of Rs. 800. Assuming an effective compound interest rate of 8% per year, determine which heat exchanger is cheaper by comparing the capitalized costs. [6+10]

5. (a) Write about tax exemptions for dividends received, contributions, investment credit and excess-profits tax.
   (b) Write about the major insurance requirements for manufacturing concerns. [8+8]

6. (a) Distinguish between salvage value and scrap value.
   (b) A piece of equipment originally costing Rs. 40,000 was put into use 12 years ago. At the time the equipment was put into use, the service life was estimated to be 20 years and the salvage and scrap value at the end of the service life were assumed to be zero. On this basis, a straight-line depreciation fund was set up. The equipment can now be sold for Rs. 10,000, and a more advanced model can be installed for Rs. 55,000. Assuming the depreciation fund is available for use, how much new capital must be supplied to make the purchase? [6+10]

7. A company must purchase one reactor to be used in an overall operation. Four reactors have been designed, all of which are equally capable of giving the required service. The following data apply to the four designs:

	Design 1	Design 2	Design 3	Design 4
Fixed-capital investment	Rs. 10,000	Rs. 12,000	Rs. 14,000	Rs. 16,000
Sum of operating and fixed costs per year (all other costs are constant)	Rs. 3,000	Rs. 2,800	Rs. 2,3500	Rs. 2,100

If the company demands a 15% return on any unnecessary investment, which of the four designs should be accepted?

8. (a) Describe the general procedure for optimizing two independent variables both analytically and graphically.
(b) The following equation shows the effect of the variables x and y on the total cost for a particular operation:

$$C_T = 2.33x + \frac{11{,}900}{xy} + 1.86y + 10$$

Determine the values of x and y which will give the least total cost. [8+8]