B. Tech.

(SEM. VIII) EXAMINATION, 2006-07

PROCESS ENGINEERING COSTING & PLANT DESIGN

Time : 3 Hours] [Total Marks : 100

Note : (i) Attempt all questions.
(ii) All questions carry equal marks.
(iii) Any data if missing may be assumed.

1 Attempt any four parts of the following : 5×4=20

(a) How is the process flow sheet prepared and presented?

(b) What is the composition and use of austenitic stainless steel? Give the composition of three main grades of austenitic steels. State the composition and use of alloy monel for chemical plant.

(c) What are the principal factors to be considered for plant layout?

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(d) What are the various safety and fire protective measures that should be included in all chemical process designs?

(e) Discuss scale up methods for reactors.

(f) What are the various equipments available for the separation of dissolved solids?

2 Attempt any **four** parts of the following: \[5 \times 4 = 20\]

(a) A bond has a face value of Rs. 1000, pays 6 per cent per year semiannually and becomes due in 4.5 years. Find the purchase price if it is bought to yield 4 per cent.

(b) Two machines have the following costs:

\[
\begin{array}{lcc}
& A & B \\
\text{First Cost} & 10,000 & 25,000 \\
\text{Salvage value} & 1100 & 1500 \\
\text{Uniform end of year expense, Rs/Year} & 3000 & 2000 \\
\text{Irregular expense, end first year Rs} & 1000 & — \\
\text{Irregular expense, end third year Rs} & — & 2500 \\
\text{Benefit from quality control, as of end of each year, Rs/year} & — & 600 \\
\text{Life of machine, years} & 2 & 5 \\
\end{array}
\]

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Compare the machines on the basis of capitalized cost with money worth 8 per cent per year.

(c) An asset costs Rs. 14000 and has a useful life of 10 years and salvage value of Rs. 2,000. Find the declining balance depreciation factor which will give the same book value at the end of 5 years as does straight-line depreciation.

(d) Two pumps under consideration for installation at a plant have the following capital investments and salvage values:

Pump A : \( C_I = \text{Rs. 40000} \quad C_{sal} = \text{Rs. 3,900} \)

Pump B : \( C_I = \text{Rs. 50000} \quad C_{sal} = \text{Rs. 20,000} \)

Using unacost method, determine what should be the common life of pumps for both to be competitive (economically equivalent). Interest rate is 10% per year. Maintenance and operational costs are negligible.

(e) Discuss the nature of depreciation. Differentiate between book value and salvage value.

(f) What are the various types of taxes and insurances?
3 Attempt any two parts of the following: 10×2=20

(a) A project requires an immediate investment of Rs. 1×10^6, 22 per cent of which is for working capital. The profit and loss statement for a year will show a net profit after taxes of Rs. 10^5 for each of the 10 years of the project life. The economic and tax life are the same. Use straight-line depreciation and a 46 per cent tax. Find the discounted cash flow rate of return and payout time without interest.

(b) Write short notes on the following:

(i) Fixed and working capital

(ii) Six-tenths rule

(iii) Lang factors

(c) What are the various criteria for economic evaluation of projects? Give the main advantage and main shortcoming of each criterion.

4 Attempt any two parts of the following: 10×2=20

(a) From the Lagrange expression, find the values of X, Y, Z that minimize the function

X + 2Y^2 + Z = 1, subject to the constraint that

X + Y + Z = 1.
(b) In drilling wells in a certain type of terrain, an oil company finds that the depth to which it can drill before changing drill bits is given by the relationship.

\[ Q_c = 300 \sqrt{T_d} \]

where \( Q_c \) = cumulative meters, \( T_d \) = drilling time, days. Find the optimum cycle time for the minimum monthly cost at a drilling rate of 4750 m/month.

(c) A company has fixed costs of Rs.3,00,000/year. At 75 percent of capacity, the variable cost is Rs. 8,00,000 and the sales realization is Rs. 15,00,000. On a single break-even chart show the effect of increasing and decreasing the selling price per unit by 10 per cent. What is the break-even point for

(i) the selling price as is,
(ii) the selling price increased by 10 per cent
(iii) the selling price decreased by 10 per cent.
5 Attempt any two parts of the following : \(10 \times 2 = 20\)

(a) A pressure vessel is to be made from a cylinder of diameter \(X\) meters capped with a hemisphere at each end. The cost for the cylindrical section is \(1800 \times X^{0.5}\) Rs/m of length and the cost of one hemispherical end is \(1400 \times X^{2.4}\) Rs.

The vessel is to hold \(40\) m\(^3\). Find the optimum dimensions and cost.

(b) A company is spending Rs. 1000 on transportation of its units from plants to four distribution centres. The supply and demand of units, with unit cost of transportation are given below:

<table>
<thead>
<tr>
<th>Plants</th>
<th>Distribution centres</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D(_1)</td>
<td>D(_2)</td>
</tr>
<tr>
<td>P(_1)</td>
<td>19</td>
<td>30</td>
</tr>
<tr>
<td>P(_2)</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>P(_3)</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Requirements</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

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What can be the maximum saving by optimal scheduling?

(c) What items are to be included in techno-economic feasibility report for the manufacture of synthetic detergent?