B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER – 2024

CHEMICAL PROJECT ENGINEERING & ECONOMICS (HONS.)

Time: 3hrs **Full Marks: 100**

Answer any *four* questions

Sl. No	CO	Question Statement	Marks
1	CO1	i. Depending upon the stages of development of a project what are the types of capital cost estimates normally used for design purposes? Describe in brief ii. What is Economy of scale and Chemical Engineering Plant Cost Index? iii. In a desalination plant, an evaporator of area 200 m^2 was purchased in 2010 at a cost of Rs. 3,00,000. In 2018, another evaporator of area 50 m^2 was added. What was the cost of the second evaporator (in Rs)? Assume the cost indices for the year 2010 and 2018 are 520 and 575.4 respectively. What will be the total capital cost for this expansion using Lang factor? iv. Differentiate between BFD, PFD and P&ID.	6+5+7+7=25
2	CO2	a) Explain the break-even chart. b) A company has purchased a double pipe heat exchanger whose first cost is Rs. 2,50,000 with an estimated life of eight years. The estimated salvage value of the heat exchanger at the end of its lifetime is Rs. 50,000. Determine the depreciation charge and book value at the end of 7th year using the sum-of-the-years-digits method of depreciation, double declining balance method and MACRS. Compare the results. c) A company offers 7.5 LPA to a fresher. She sets aside 10% per year for retirement in 40 years' time. Assuming life span of 20 years more after retirement she invested in a plan that offered 8LPA for 20 years of retirement income. i. What was the yearly interest rate? ii. How much money was invested in the retirement plan before withdrawals began? iii. If annual inflation rate is 2%, what will be the purchasing power of the cash available at retirement? iv. What is the purchasing power of the retirement income in the first and twentieth year of retirement?	3+12+10=25
3	CO3	a) For a project a new chemical plant is going to be built and will require the following capital investments (in $ million): Cost of land, L= $10, Total fixed capital investment $140, Fixed capital investment during year 1= $90, Fixed capital investment during year 2=$60, working capital=$30 at the end of year 2 i.e., at the time of plant start up. Yearly sales revenue after start up = $70 per year, Cost of manufacturing excluding depreciation allowance after start up = $30 per year. Calculate each discounted profitability criteria when taxation rate is 45%, salvage value of the plant is $10 after the project life of 10 years. Assume a discounted rate of 10% per annum and 5-year MACRS.	25
4	CO3	a) Differentiate between EOQ and EPQ and state their limitations. b) Explain Tornado chart and Strauss chart. c) A reactor needs to be insulated to cut down significant energy loss. Two types of insulation are available in two thicknesses. The estimated cost of the insulation and the estimated yearly savings in energy costs are as below. Acceptable rate of return is 15%. Using non discounted profitability criteria calculate, i. ROROII and IPBP for the insulations. ii. Value of the IPBP equivalent to the 15% internal rate of return. iii. Which options is the best.	5+5+15=25

Options No	Available alternatives	Project Cost (Rs.)	Yearly cash flow (Rs.)
1	No insulation	0	0
2	B-1" thick	25000	1400
3	B-2" thick	45000	1900
4	A-1" thick	55000	2000
5	A-2" thick	95000	2400

5	CO4	a) What are the key considerations for Brownfield projects? b) What are the main positive and negative traits of Greenfield projects? c) Explain economy of scale. Calculate the capital cost of two water gas shift reactors (in million $) for a flow rate of 942 kmol h^{-1} through each reactor. The known capital cost of $40.59 million was obtained for a flow rate of 15600 kmol h^{-1} through one reactor. The scaling factor is 0.85. d) Consider the scale up of a batch reactor from 10 L to 10,000 L vessel. The small reactor has a height-to-diameter ratio of 3. The impeller diameter is 30% of the tank diameter. Agitator speed is 500 rpm and 3 Rushton impellers are used. Determine the dimensions of the large reactor and agitator speed for: Constant P/V, Constant impeller tip speed, Constant Reynolds number. Assume geometric similarity.	8+5+5+7=25