

(3 Hours)

[Total marks: 80]

- N.B.:** (1) Question No 1 is compulsory
 (2) Attempt any three questions out of remaining five questions
 (3) Assume suitable data if necessary and indicate it clearly.
 (4) Figures to the right indicate full marks.

- Q.1** Solve any four questions of the following. **20**
- Explain the importance of safety and Environmental aspects in process design.
 - Discuss different types of depreciation.
 - Differentiate between tray tower and packed tower distillation column.
 - What is P & ID? Explain its significance.
 - List out various cost elements which decided total product cost.
- Q.2** (a) What is grassroot design and how it is different than retrofitting? What are the various motivations for retrofitting? Why contingency is added to process? **10**
- (b) Explain the concept of capitalized cost. A new piece of equipment costs Rs. 80000 & will have a scrap value of 10% of initial cost, at the end of its useful life period of 12 years & interest is compounded at 5% per year. What is the capitalized cost of equipment? **10**
- Q.3** (a) Find the work required to compress 120 gmol/s of an ideal gas at 280 K from 300 kPa to 1500 kPa using (i) adiabatic compression (ii) isothermal compression and (iii) staged compression. For staged compression also find out outlet 'T' of gas from each compressor. $R = 8.314 \text{ J/gmol K}$, $\gamma = 1.4$. **12**
- (b) Estimate bare module cost of adiabatic compressor designed in part (a-i) of this question: **08**
 Data:
 $\eta_m = 0.9$; $\eta_c = 0.8$; $C_o = \text{Rs. } 11,50,000$; $S_o = 100 \text{ hp}$; $\alpha = 0.77$; $F_D = 1$;
 $MF = 3.11$; $UF = 3.12$
- Q.4** (a) What is Break Even analysis? Explain with graphical representation. Also derive the equation for break-even point. **10**
- (b) 95% of acetone is to be recovered from acetone-air mixture containing 20 gmol/s of air and 2 gmol/s of acetone by using absorption column and using water as a solvent at 300 K and 10 bar. Absorption factor for acetone is 1.4. Find required flow rate of solvent, theoretical number of stages and composition of leaving vapor and liquid streams of absorption column. **10**
 Data:

Components	Vapor Pressure (bar)
Acetone	0.331
Water	0.035

- Q.5** (a) Explain six-tenth rule used for cost estimation. A reactor of 1200 gal. capacity purchased in 2001 has cost of Rs. 250000. Cost index in 2001 is 240. Using six-tenth rule, calculate the cost of the reactor of 2500 gal. capacity in 2008 if cost index in 2008 is 250. **10**
- (b) Write a short note on: **10**
- i) Equipment sizing procedure of Pump
 - ii) Batch process vs Continuous process

- Q.6** (a) Consider the following data related to 3 alternative investment options: **10**

Investment No.	FCI (Rs.)	WCI (Rs.)	Salvage Value (Rs.)	Service Life (Years)	Annual Profit (Rs.)
1	50,000,00	5,00,000	5,00,000	5	9,00,000
2	85,000,00	5,00,000	7,50,000	7	15,00,000
3	1,05,000,00	7,50,000	10,00,000	8	18,00,000

Straight line method is used for depreciation accounting. Which investment should be recommended on the basis of payout period?

- (b) Explain process design of Orificemeter **10**
