

**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 the following (Any four) 20

- a) Explain how chemical products are classified.
- b) Write a short note on NPSH of Pump.
- c) Explain "Net Present Worth method" of profitability analysis
- d) Describe the types of capital cost estimates.
- e) Discuss the factors to be considered during selection of trays in distillation column.
- f) Explain about "Annuities and Perpetuity".

Q.2. a) Explain the following: 10

- (i) Comparison of alternative investments based on incremental rate of return
- (ii) Importance of "process control" in process engineering.

b) Explain the short cut methods for sizing of the following equipments: 10

- (i) Process vessels
- (ii) Pumps

Q.3. a) The purchase cost of shell & tube heat exchanger with 100 ft<sup>2</sup> of HT area, was Rs. 150000 in year 1980. What will be purchased cost of similar heat exchanger with 200 ft<sup>2</sup> HT area in 1980, if purchased cost-capacity exponent is 0.6 for HT area ranging from 100 to 400 ft<sup>2</sup>? If this exponent is 0.81 for HT area ranging from 400 to 2000 ft<sup>2</sup>, what will be purchased cost of heat exchanger with 1000 ft<sup>2</sup> HT area in year 1985? Cost index in 1980 and 1985 are 200 and 280 respectively. 10

b) Explain 12 steps in design of distillation column. 10

Q.4. a) It is proposed to use an absorption column to recover 99.2% of Acetone from a gas mixture that has composition as 94.3 gmol/s of air, 5 gmol/s acetone and 0.7 gmol/s of formaldehyde. If pure water is used as a solvent, estimate required flow rate for following conditions of column pressure and solvent temperature and write appropriate conclusion from the results obtained. Vapor pressures of acetone at 300 K and 330 K are 0.33 and 1.03 bar respectively. Also calculate number of trays required in absorber at column pressure of 2 bar and solvent temperature of 300 K. 10

P (column) (bar)	2	2	10	10
T (water) (K)	300	330	300	330

b) Suppose an entrepreneur want to obtain a loan of Rs. 1000000 for retrofitting of process plant. The interest rate is 9 % compounded semiannually and it is agreed to retire the loan in 4 years. How much monthly payment need to be made to retire the loan? 10

- Q.5 a) Find the work required to compress 50 gmol/s of an ideal gas at 320 K from 300 kPa to 1800 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.  $R = 8.314 \text{ J/gmol K}$ ,  $\gamma = 1.4$ . **10**
- b) Write a short note on the following: **10**
- (i) Process Flow Diagram (PFD)
  - (ii) FUG Method
- Q.6. a) Explain the following: **10**
- i) Total Product Cost
  - ii) Rate of Return on Investment
- b) A chemical company is considering adding a production unit which will require a FCI of Rs. 12,00,000 and WCI of Rs. 3,00,000 and will yield a profit of Rs. 2,80,000. An alternative investment has been proposed requiring FCI of Rs. 17,00,000 and WCI of Rs. 5,00,000 and yielding an annual profit of Rs. 3,50,000. Minimum rate of return required for new investment is 14%. Which investment is recommended? **10**

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