



# VII SEMESTER B.TECH. (CHEMICAL ENGINEERING)

### **END SEMESTER EXAMINATIONS, NOV/DEC 2016**

## SUBJECT: PROCESS ENGINEERING ECONOMICS [CHE 401]

#### REVISED CREDIT SYSTEM (23/11/2016)

Time: 3 Hours

#### MAX. MARKS: 100

#### Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- ✤ Missing data may be suitably assumed.

1A.	A person borrows Rs.20,000 at 8% compounded quarterly. He wishes to repay the money with 10 equal semi-annual installments. What must be the size of the payment in order to repay the amount?	04
1B.	Derive the expression for the present worth of a series of cash flow forming gradient series.	08
1C.	<ul><li>A Rs.980, 8% quarterly bond is purchased at t=0 for Rs. 1020 and sold three years later for Rs. 960, then</li><li>(a) What was the quarterly yield on the investment?</li><li>(b) What was the effective annual interest?</li></ul>	08
2A.	A person deposits Rs. 1000 in a fund at the end of 1991. He goes for end of year deposits in the fund until the end of 2010, when his last deposit is made. The fund pays 5% compounded annually. If the size of a deposit at the end of year k is given by $A_k 0.90 = A_{k-1}$ , how much will be in the fund immediately after the last deposit.	06
2B.	A copper ore deposit is purchased for Rs. 3,200,000 and has an estimated amount of ore sufficient to last for 20 years as per the survey of geologists. If the investors require a 18 per cent stipulated return and if a 5 per cent conservative interest rate is used, what should be the annual rate of return on the operations?	08
2C.	Define the following terms. External rate of return, capitalized cost, continuous cash flow, payout period, MARR, MACRS	06
3A.	A material handling system was purchased for Rs. 100,000. It has a life of nine years and a terminal salvage value of Rs. 5,000 at that time. Using the double declining balance method, determine the depreciation charge and book value for all the years. (What is your conclusion from the answer?)	05

**3B.** Four investment proposals W, X, Y and Z are being considered by a chemical company. Proposals X and Z are mutually exclusive. Proposal Y is contingent on either X or Z. Proposals W and Y are mutually exclusive. A budget limitation of Rs. 200,000 exists. Either proposal W or proposal Z must be included in the alternative selected. Using a MARR of 10%, determine the preferred alternative using the savings/ investment ratio method.

EOY	CF(W)	CF(X)	CF(Y)	CF(Z)
0	Rs -100,000	Rs -140,000	Rs -20,000	Rs -15,000
1	10,000	7,500	3,000	1,000
2	10,000	8,500	3,000	1,500
3	10,000	9,500	3,000	2,000
4	10,000	10,500	3,000	2,500
5	20,000	30,000	3,000	3,000

4A. A sulfur mine having 85,000 units of sulfur has the initial cost of Rs. 1,300,000. The gross income for this mineral is Rs. 36/unit. The operating and maintenance costs are Rs. 12/unit. If during the first four years of operation, the mine yields 30,000 units, 25,000 units, 20,000 units and 10,000 units of sulfur respectively, determine the after tax cash flow for all the years. Take the tax rate as 50% and depletion percentage as 22%. Use the better method of depletion.

4B. A company has a reactor that it has been using for the past four years. The reactor originally costs Rs. 18,000. Today the reactor can be sold for Rs. 10,000. The reactor can be used for 10 years more and will have Rs. 3000 salvage value at that time. The annual operating and maintenance cost for the reactor equals Rs. 4500/year. Because of the increased demand, a new reactor of smaller capacity can be purchased. If the old reactor is retained, a new reactor of small capacity will be purchased at a cost of Rs. 15,000 and will have salvage value of Rs. 3000 in 10 years. This new reactor of small capacity will have annual operating and maintenance cost

equal to Rs. 4000/year. The old reactor can be sold and a new reactor of larger capacity purchased for Rs. 26,000. This reactor will have Rs. 3000 salvage value in 10 years and will have annual operating and maintenance cost equal to Rs. 7500/year. Based on MARR of 15%, which reactor do you recommend using future worth method?

**5A.** A polymer is produced in a batch operation. Each cycle consists of operating time necessary to complete the reaction and a total time of 1.4 hours for discharging and charging. The operating time per cycle T in hours is given by  $T=1.5 P^{0.25}$  where P is the kg of product produced per batch. The operating costs during the reaction period are Rs. 20 per hour and during discharging and charging Rs. 15 per hour. The annual fixed costs C for equipment vary with the size of batch according to the following relation

 $C = 340 P^{0.8}$ 

The annual production is 1 million kgs of product. Also at this capacity, raw material and installation cost amounts to 0.26 million/ year. Determine the optimum cycle time.

5B.	<ul> <li>A chemical plant is manufacturing a product at the rate of P units per day. The variable cost per unit is (18.40+0.07 P<sup>1.3</sup>). Total daily fixed charges are Rs. 1250 and other expenses are at a rate of Rs. 6000/day. If the selling price per unit is Rs.140. Determine</li> <li>(a) The profit /unit of product giving the minimum cost per unit of product.</li> <li>(b) Profit/unit of product giving maximum profit per unit of time.</li> <li>(c) Production rate at breakeven point.</li> </ul>	12
6A.	The filtering characteristics of an aqueous slurry given by the equation $Q = (K\theta_f)^{0.5}A$ , such that k value is $1.45 \times 10^{-6}$ , where Q is tons of filtrate in filtering time of $\theta_f$ hours, A is area of the filter, m <sup>2</sup> . The slurry is to be filtered at constant pressure in a plate and filter press( with a=0.25) at a rate to process an average of 1.35 ton/hr of feed and it is to be washed with an equal amount of water equal to one-eighth the volume of the filtrate. The dumping and assembling time is established at 6 hr. The direct costs for power, labor during filtering and washing are Rs. 14 per m <sup>2</sup> , and cleanouts cost Rs. 10 per m <sup>2</sup> . Inventory charges may be neglected. The plant operates 6000 hr/ yr. and the slurry feed contains 11 per cent (weight) solids and the cake contains 73 per cent solids. Annual fixed costs may be taken as Rs. 20 per m <sup>2</sup> of filtering area. What is the minimum annual cost, the optimum cycle time?	16
6B.	The fixed cost for insulating a steam pipe is given by $C_F=40S+35 \text{ Rs/yr.}$ where S is the thickness of insulation in mm. The annual steam cost is $C_D=110 \text{ Rs/yr.}$ Determine the optimum insulation thickness.	04