University of Mumbai
Examinations Commencing from
QP CODE: 93576
Program: Chemical Engineering
Curriculum Scheme: Rev2019
Examination: TE Semester VI
Course Code: CHC604 and   Course Name: Process Engineering and Economics
Time: 2 hours 30 minutes   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks (20 Marks)
1.	Formulation of the design problem requires a _____ _____
Option A:	product specification
Option B:	product cost
Option C:	raw material cost
Option D:	Raw material properties
2.	Commodity chemicals have ----------------
Option A:	Low added value and large sales volume
Option B:	High added value and large sales volume
Option C:	Low added value and low sales volume
Option D:	High added value and low sales volume
3.	_____ is a series of equal payments occurring at equal time intervals.
Option A:	Depreciation
Option B:	Present worth
Option C:	Annuity
Option D:	Discount
4.	Fixed and Working capital investment for one manufacturing plant are Rs. 50 Lakhs and Rs. 10 Lakhs respectively. The plant earns profit of Rs. 8 Lakhs per annum. So rate of return for this plant will be _____ __
Option A:	16%
Option B:	80%
Option C:	17.24%
Option D:	13.33%
5.	What is static discharge head of a pump if the pump is below the free surface of the liquid in receiver? P = Absolute pressure at free surface of liquid in receiver and Z = vertical distance between free surface of liquid in receiver and centreline of pump
Option A:	P-Z
Option B:	P+Z
Option C:	Z
Option D:	P+2Z

6.	In multicomponent distillation process, mole fraction of light key component (LK) in distillate and residue are 0.9 and 0.1 respectively; mole fraction of heavy key component (HK) in distillate and residue are 0.05 and 0.8 respectively. Then by Fenskey's equation, what will be the minimum number of trays required in distillation column if vapor pressure of LK and HK are 2.17 and 0.8 atm respectively (assume constant relative volatility throughout the column)?
Option A:	2.15
Option B:	0.8
Option C:	4.98
Option D:	0.2
7.	If we arrange the types of capital cost estimates in order of their accuracy from highest accuracy to the least accuracy, then one which will come at 2nd position will be:_____
Option A:	Study estimate
Option B:	Order of magnitude estimate
Option C:	Definitive estimate
Option D:	Detailed estimate
8.	In economics, Break-even point is the point at which_____
Option A:	Fixed capital is equal to working capital
Option B:	Maximum profit can be earned
Option C:	Loss occurs
Option D:	Total product cost equals total income
9.	Find the future amount of Rs. 18000 invested at the rate of 8% nominal interest for 2 years, if interest is compounded monthly.
Option A:	Rs. 21057.45
Option B:	Rs. 21089.86
Option C:	Rs. 21111.98
Option D:	Rs. 20995.20
10.	The cost of equipment in year 2000 was Rs. 130000 and cost index at the time was 280. The cost of similar equipment in year 2020 is Rs. 195000. Then what is the cost index in year 2020?
Option A:	420
Option B:	330
Option C:	380
Option D:	440

Q2	Solve any two questions out of three:	(10 marks each)
A	Draw and explain the concept of "onion diagram" in process engineering. Also explain guidelines for selection of batch and continuous process.	

B	The original value of a piece of equipment is Rs. 22,000, completely installed and ready for use. Its salvage value is estimated to be Rs. 2000 at the end of a service life estimated to be 10 years. Determine the asset (or book) value of the equipment at the end of 5 years using (i) Straight-line method. (ii) Declining-balance method.
C	Carbon dioxide is to be conveyed from the top of the stripper of ammonia plant to urea plant through a pipe line. Referring the following data, calculate: i. Inside diameter of the pipe ii. Nature of flow (laminar or turbulent) iii. Total pressure drop in pipe Data: Flow rate of CO_2 = 1000 t/day Total length of pipe = 800 m Available pressure at inlet of pipe = 24 kPa g Discharge pressure of CO_2 from pipe required = atmospheric Velocity of gas through pipe = 20 m/s No. of $90°$ elbows (K = 0.75) in pipe line = 8 No. of butterfly valve (K = 0.24) = 1 No. of flow nozzle = 1(pressure drop through flow nozzle can be neglected) Temperature of gas = $60°$ C Viscosity of CO_2 gas = 0.016 cP R = 0.0821 atm.m^3/kmol.K

Q3.	Solve any two questions out of three: (10 marks each)
A	Find out the power required for a turbo blower as well as the discharge temperature of air from blower for the following. Duty: Fluid = Atmospheric air Capacity = 1084 m^3/h Discharge pressure = 2 atm a C_p/C_v for air = 1.395 Inlet temperature of air = 50 °C Efficiency of turbo blower = 0.7
B	Explain the design and working of short path distillation unit along with its operation
C	Design an absorber to recover 95% of acetone from acetone air mixture containing 10 gmol/s of air and 1 gmol/s of acetone. Pressure in the column is 10 bar and pure water is used as solvent at 300 K. Calculate : 1. Flow rate of solvent 2. Number of trays required in absorber 3. Flow rate of all components in the liquid and vapor stream leaving an absorber **Antoine constant data:**

Component	A	B	C
Acetone	16.6513	2940.46	- 35.93
Water	18.3036	3816.44	- 46.13

Q4	**Solve any four questions out of six:** (05 marks each)
A	Differentiate between Packed tower and Tray tower used for distillation operation.
B	Write a short note on "NPSH of pump"
C	A proposed manufacturing plant requires an initial fixed-capital investment of Rs. 900000 and Rs.100000 of working capital. It is estimated that the annual income will be Rs. 800000 and the annual expenses including depreciation will be Rs. 520000 before income taxes. The investment will be worthwhile only if minimum annual return of 15 percent after income taxes is achieved. Income taxes amount to 34 percent of all pre-tax profits. Determine if the investment will be worthwhile or not.
D	There are two options for investing money in project. Investment option 1 requires FCI of Rs. 5000000, salvage value of project is 500000 and service life is 5 years while option 2 requires FCI of Rs. 8500000, salvage value of project is 750000 and service life is 7 years. Average annual profit expected from option 1 and 2 are Rs. 900000 and Rs. 1492857 respectively. For depreciation calculation, straight line method is used for both the options. Then on the basis of payout period, determine which option is more feasible.
E	Tray stack in distillation column has 23 number of trays and tray spacing is 0.6 m. Diameter of the tray stack is 1.06 m. Then calculate present bare module cost of of this tray stack based on the following data: C_o = Rs. 13860; L_o = 10 ft; D_o = 2 ft; α = 0.97; β = 1.45; F_m = 0; F_s = 1; F_t = 1.8; MF = 1; UF at present time = 3.12.
F	The purchased cost of heat exchanger with 10 m^2 heat transfer area was Rs. 400000 before 5 years. Then what will be the present purchased cost of similar heat exchanger with 30 m^2 heat transfer area based upon six-tenth factor rule? The cost index before 5 years was 660 and the same at present is 790.

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