Chemical Dept.

Bachelor Of Engineering

Question Papers Nov-Dec 2019

Sem–III to VIII

SE (III) (CHEM) (Choice Based) 14/11/19

(3 hours) **Total Marks:80**

N.B: (1) Question no.**1** is **compulsory.**
(2)Attempt any **three** questions from remaining **five** questions.
(3)**Figures** to the **right** indicate **full** marks.
(4)Assume suitable data if necessary.

1. (a) Use Laplace Transform to evaluate $L\left\{\frac{sint\cos 2t}{e^t}\right\}$ **(5)**

(b) If $A=\begin{bmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & -2 \end{bmatrix}$, find the Eigen values of A^2+I **(5)**

(c) Show that the function $f(z)=\frac{1}{r^2}[\cos 2\theta - i\sin 2\theta]$ is analytic. **(5)**

(d) A manufacturer of metal pistons finds that on average 12% of his pistols are rejected because they are either oversized or undersized. What is the probability that a batch of 10 pistons will contain not more than 2 rejects. **(5)**

2. (a) The average of marks scored by 32 boys is 72 with standard deviation 8. While that of 36 girls is 70 with standard deviation 6. Test at 1% level of significance whether the boys perform better than girls ($Z_\alpha = 2.58$). **(6)**

(b) Find analytic function whose imaginary part is $\tan^{-1}\left(\frac{y}{x}\right)$. **(6)**

(c) Reduce the following quadratic form to canonical form. Also find it's rank and signature.

$x^2+2y^2+2z^2-2xy-2yz+zx$ **(8)**

3. (a) Show that the matrix A is diagnosable, where $A=\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$. **(6)**

(b) Find the inverse Laplace Transform of $\frac{1}{(S^2+4S+13)^2}$ using convolution theorem. **(6)**

(c) (i) A continuous random variable has probability density function

$f(x)=6(x-x^2),\ 0\le x\le 1$ find mean and variance **(4)**

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(ii) If mean of the following distribution is 16 find m and n **(4)**

X	8	12	16	20	24
P(X= x)	1/8	m	n	1/4	1/12

4. (a) Evaluate $\int_0^\infty \frac{\cos at - \cos bt}{t} dt$ using Laplace transform **(6)**

(b) Find the orthogonal trajectories of the family of curves $x^3y - xy^3 = c$ **(6)**

(c) 300 digits were chosen at random from a table of random number. The frequency of digits was as follows: **(8)**

Digit	0	1	2	3	4	5	6	7	8	9	Total
Frequency	28	29	33	31	26	35	32	30	31	25	300

Using χ^2 – test examine the hypothesis that the digits were distributed in equal numbers in the table at 5% LOS.

5. (a) Find the bilinear transformation which maps the points $z = 1, i, -1$ onto the points $w = i, 0, -i$ **(6)**

(b) From the following data calculate Spearman's rank correlation coefficient R

X: 10 12 18 18 15 40

Y: 12 18 25 25 50 25 **(6)**

(c) Solve using Laplace Transform $(D^2 + 2D + 5)y = e^{-t}\sin t$,

Where $y(0) = 0$, $y'(0) = 1$ **(8)**

6. (a) A manufacturer knows from his experience that resistance of resistors he produces is normal with mean 100 ohms and standard deviation is 2 ohms. What percentage of resistors will have resistance between 98 ohms and 102 ohms (for a standard S.N.V the area under the curve between Z=0 and Z=1 is 0.3413). **(6)**

(b) Verify the Cayley-Hamilton Theorem for matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$. **(6)**

(c) Find the inverse Laplace transform of the following functions :

$(i)\ \log\left[\frac{s+a}{s+b}\right]$, $(ii)\ \frac{e^{-5s}}{(s-2)^4}$ **(8)**

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SE (III) (Chem.) (Choice Based) 18/11/19

Time: 3 Hours **Marks: 80**

Please check whether you have got the right question paper.

N.B.: 1. Questions no. 1 is compulsory.

2. Attempt any three questions from remaining five questions.

Q.1 Attempt **any four** questions of the following: **[20]**

a) Explain Geometry & hybridization of BrF_3 molecule on the basis of VSEPR theory.

b) Discuss preparation, bonding, hybridization and geometry of $Fe_2(CO)_9$ molecule.

c) Differentiate between Kinetically controlled and thermodynamically controlled reaction.

d) Discuss structure and stability of carbanion.

e) Differentiate between Photochemical & Thermochemical reactions.

f) Give Nomenclature for following.

i) $Na_2[Zn(OH)_4]$ ii) $[Co(NH_3)_6]Cl_3$

Q.2 a) Write note on Effective atomic number (EAN). Explain with an example. **[05]**

b) Draw Molecular Orbital Diagram of F_2 molecule. Comment on Bond order and Magnetic character. **[05]**

c) Write note on Iron containing Protein. **[05]**

d) Explain Quantum yield. Give reasons for high Quantum yield. **[05]**

Q.3 a) Discuss Sulphonation of naphthalene as kinetically controlled and thermodynamically controlled reaction. **[05]**

b) Explain S-P and P-P orbitals overlapping for formation of σ & σ^* by LCAO method. **[05]**

c) Discuss Reimer-Tiemann reaction with its applications. **[05]**

d) Discuss Biochemistry of Zinc containing metalloprotein. **[05]**

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Q.4
a) Calculate CFSE for d^5 and d^7 system in strong field and weak field for octahedral complexes. [05]
b) Explain Wohl-Ziegler reaction. [05]
c) What is hydrogen bonding? Explain Intra molecular and inter molecular hydrogen bonding with an examples. [05]
d) Discuss Jablonski diagram. [05]

Q.5
a) Explain Pinacol - Pinacolone rearrangement reaction. [05]
b) Explain geometrical isomerism with example in co-ordination compounds with respect to CN-4. [05]
c) Define and explain Intermediate and Transition state with suitable example. [05]
d) Differentiate between Fluorescence & Phosphorescence. [05]

Q.6
a) Calculate EAN for following Compound
i) $[Pt(Cl)_4(H_2O)_2]$ ii) $K_4[Fe(CN)_6]$. [05]
b) Discuss the formation and structure of carbocation. [05]
c) Explain oxygen transportation in hemoglobin. [05]
d) Discuss the VBT and give the limitations of VBT. [05]

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20/11/19.

B.E - II Sem - Chem - CBCS

Time: 3 Hours Marks: 80

N. B.: (1) Question No. 1 is compulsory.
(2) Attempt any three questions from remaining five questions.
(3) Assume suitable data if necessary.

Q. 1 Answer any Four questions [20]

a) Derive Newton's law of viscosity and mention the various units of viscosity.
b) A plate of 0.05 mm at a distance from a fixed plate moves at 1.2 m/s and requires a force of 2.2 N/m^2 to maintain this speed. Find the viscosity of the fluid between the plates.
c) Derive equation of continuity for compressible and incompressible fluids.
d) What do you mean by compressible fluids and explain what are the objectives of learning compressible flow in short.
e) Write the classification of pressure measurement devices.

Q. 2

(a) Explain the different types of fluid flow. (any five types) [10]
(b) Oil of viscosity 0.098 kg/(m.s.)and sp.gr 0.9 flows through a horizontal pipe of 2.5 cm diameter. If the pressure drop per meter length of pipe is 0.12 kgf/cm^2.Determine (i) The rate of flow.(ii) Reynolds number. (iii) The power required per 50 m length pipe to maintain flow. [10]

Q. 3

(a) Water is flowing through a pipe having diameters 30 cm and 50 cm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 3 kgf/cm^2 and at the upper end is 1.5 kgf/cm^2. Determine the difference in datum head if the rate of flow through pipe is 50 lit/sec. [10]
(b) Draw and explain the propagation of pressure waves, when Ma = 1, Ma<1 and Ma>1 [10]

Q. 4

(a) Derive an expression for the velocity distribution, shear stress distribution and relation between average velocity and maximum velocity for the laminar flow of fluid through the circular pipe. [10]
(b) Explain any two types of valves with neat sketch. [10]

Q. 5

(a) Find the Mach number when an aeroplane is flying at 1100 km/hr through still air having a pressure of 7 N/cm^2 and temperature -5^{0}C, wind velocity may be taken as zero. Take R = 287.14 J/kg. ^{0}K. Calculate the pressure temperature and density of air at stagnation point on the nose of the plane. Take k = 1.4 [10]

(b) State the different types of pumps and explain the centrifugal pump with neat sketch. [10]

Q. 6

(a) Derive an expression for hydrostatic equilibrium [05]
(b) Define and explain drag force. [05]
(c) Define and give the significance of Mach Number. [05]
(d) Explain NPSHR and NPSHA [05]

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22/11/19.

S.E/SEM II). Chemical / Choice Base

Time: 3 Hours **Total Marks: 80**

N.B.:

(i) Question No.1. is compulsory.
(ii) Attempt any three questions out of remaining five questions.
(iii) Assume suitable data and justify the same.
(iv) Figures to the right indicate full marks

Q 1 Explain **any Four.** 20

(a) Define Fugacity coefficient. What is its physical significance?

(b) Concept of Entropy with example.

(c) Explain the Procedure to prepare Enthalpy –Temperature diagram.

(d) Reversible and irreversible process with example.

(e) Calculate the coefficient of performance of carnot refrigerator operating between -20 ^{0}C and 30^{0}C.

Q 2 (a) An ideal gas is undergoing a series of three operations : The gas is heated at constant volume from 300 K and 1 bar to apressure of 2 bar. It is expanded in a reversible adiabatic process to a pressure of 1 bar. It is cooled at constant pressure of 1 bar to 300 K. Determine the heat and work effects for each step. Assume Cp = 29.3 kJ/kmol K 12

(b) Explain Clausius Inequality with equation. 08

Q 3 (a) A 40 kg steel casting (Cp = 0.5 kJ/kg K) at a temperature of 450 ^{0}C is quenched in 150 kg of oil (Cp = 2.5 kJ/kgK) at 25 ^{0}C. If there are no heat losses, what is the change in entropy of a) the casting b) the oil c) both considered together? 10

(b) Viral coefficient for ethane is B= -15.67x 10^{-2} m3/kmol and C = 9.65 x10^{-3} m^6/kmol^2. Calculate the isothermal work of compression for one kmol of a gas from 1 bar to 15 bar at 100^{0}C. Compressibility factor Z_1 = 0.9949 and Z_2 = 0.9203 .Viral equation of state is: 10

$$\frac{PV}{RT} = Z = 1 + \frac{B}{V} + \frac{C}{V2}$$

Q4 (a) Estimate the fugacity coefficient of n-hexane at 600 K and 800 Kpa using van der Waals equation of state 10

Data: T_c= 507.4 K, P_c= 2969 kPa

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(b) Find the volume of n.pentane at 500 K and 20 bar for a gas which obeys Redlich Kwong Soave equation of state. 10

Redlich Kwong Soave equation of state is given by:

$$P = \frac{RT}{(V-b)} - \frac{a\alpha}{V(V+b)}$$

Where:

$$a = 0.42748\frac{R^2T_c^2}{P_c} \quad \text{and} \quad b = 0.08664\frac{RT_c}{P_c}$$

$$\alpha = [\,1 + S\,(\,1 - \sqrt{T_r}\,)\,]^2$$

$$S = 0.48508 + 1.55171\,w - 0.15613\,w^2$$

Tc = 469.9 K, Pc = 33.7 bar, ω = 0.251

Q5 (a) Explain the concept of exergy and get the expression to calculate exergy loss when the system changes its state. 10

(b) A reversible heat engine operates between source temperature of 900 K and the sink temperature of 315 K. The engine is coupled with the heat pump working between the temperature of source at 253 K and the sink of 315 K . The net work done during the process is 320 KJ and the energy supplied by the higher temperature source at 900 K is 2000 KJ. Find the work done by both the engines and the energy supplied to other sources and the sink. 10

Q 6 (a) Derive an expression for Joule Thomson Coefficient for van der Waals gas and find the relation for inversion temperature and inversion pressure. 10

(b) Derive an equation for entropy departure of a gas obeying Redlich Kwong equation of state. 10

$$P = \frac{RT}{v-b} - \frac{a}{\sqrt{T}v(v+b)}$$

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25-11-2019

SE / Chem / Choice based / Sem - II

(3 Hours) [Total Marks: 80]

N.B 1. Question number **one** is compulsory.
2. Attempt any three of the remaining questions.
3. Each question carries equal marks.
4. Figures to the right indicate marks.
5. Make suitable assumptions when required.

1 (a) Find the average molar mass of air containing 79% (v/v) N_2 and 21% (v/v) O_2. Compute the composition of air by mass. **05**

(b) Draw the block diagram of the following unit operations and identify the tie component in the unit operations if any. Distillation, gas absorption and drying. **06**

(c) Define adiabatic flame temperature, heat of combustion and heat of reaction. **06**

(d) Convert 294 g/L H_2SO_4 to normality and molarity **03**

2 (a) A solution of potassium dichromate in water contains 15% (w/w) $K_2Cr_2O_7$. Calculate the amount of $K_2Cr_2O_7$ that can be produced from 1500 kg of this solution, if 700 kg of water is evaporated and remaining solution is cooled to 293 K. Given that the solubility of $K_2Cr_2O_7$ at 293 K is 115kg/1000kg water. **05**

(b) A mixture of phenol and water forms two separate liquid phases, one rich in phenol and other rich in water and the composition of the layers are 70% and 9 %(w/w) phenol respectively. If 500kg of phenol and 700kg of water are mixed and layers allowed to separate, find the individual mass of the layers. **05**

(c) Fresh fruit juice contains 15% solids and rest water. It is desired to concentrate this juice, by evaporation to a solid concentration of 40%. However, to avoid a flat taste of the product, it is not advisable to do direct evaporation of the entire juice. A portion of the fresh juice is bypassed the evaporator and mixed with the evaporated juice containing 55% solids. Thus a juice containing 40% solids is obtained from the process. Calculate the fraction of juice that bypasses the evaporator. All composition is by mass. **10**

3 (a) A combustion reactor is fed with 50kmol/h of butane and 2000kmol/h of air. Calculate the % excess air used and composition of the flue gas if conversion is 100%. **10**

(b) Acetylene is produced as per the reaction: **10**

$$CaC_2 + 2H_2O \rightarrow C_2H_2 \uparrow + Ca(OH)_2$$

If 100L of gas is burnt per hour at 298K and 98.68kPa ,calculate the amount of CaC_2 in kg which must be used in the acetylene lamp, at the above temperature & pressure, to get 15 hours service of the lamp. CaC_2 reacts to give acetylene gas to burn in the lamp.

4 (a) Formaldehyde is produced by dehydrogenation of methanol. The per pass conversion is 67%. The product leaving the reactor is fed to separation unit where formaldehyde is separated from methanol and hydrogen. The separated methanol is recycled to reactor. If the production rate of formaldehyde is 1000kg/h, calculate the combined feed ratio and the flow rate of methanol required to the process as fresh feed. **10**

(b) In production of bean oil,beans containing 10%(w/w) oil and 90%(w/w) solids are ground and fed to the reactor,where they remain suspended in hexane. The feed ratio is 3kg hexane/kg beans.All oil in the beans is extracted into the hexane. This mixer effluent passes to a filter.The filter cake contains 75%(w/w) solids and rest bean oil and hexane.Filter cake is discarded and the the liquid filtrate is send to an evaporator, where hexane is vaporised and thus separating the oil.The hexane vapour is condensed and recycled to the reactor. Calculate the fresh hexane feed per 100kg of beans fed and the recycle to fresh feed ratio. **10**

5 (a) Temperature of oxygen is raised from 350K to 1500K .Calculate the amount of heat that must be applied for raising the temperature of 32kg of oxygen using C_p data provided. $C_p=a+bT+cT^2+dT^3$ **10**

Gas	a	$b\times10^3$	$c\times10^6$	$d\times10^9$
O_2	26.0257	11.7551	-2.3426	-0.5623

(b) A natural gas has the following composition on mole basis: **10**
CH_4=84%,C_2H_6=13% and N_2=3%.Calculate the heat to be added to heat 200kg of natural gas from 311K to 533K.C_{pm} values in kJ/(kmol K).

Gas	C_{pm} (311-298 K)	C_{pm} (533-298 K)
CH_4	36.0483	41.7800
C_2H_6	53.5240	67.4954
N_2	29.1317	29.5378

6 (a) Obtain an empirical equation for calculating the heat of reaction at any temperature T K for the reaction: **10**

$$CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(g)}$$

Data : ΔH_R^0 = -90.41 kJ/mol

Component (gas)	a	$b\times10^3$	$c\times10^6$	$d\times10^9$
CO	29.0277	-2.8165	11.6437	-4.7063
H_2	28.6105	1.0194	-0.1476	0.769
CH_3OH	21.137	70.843	25.86	-28.497

(b) Give the step wise procedure to calculate the reboiler load in a distillation unit. List the parameters required for the computation of the above. **10**

S.E. chemical / Choice Based / 28/11/2019 - Sem III

Paper / Subject ~~Code: 50706~~ / Chemical Technology

(3 Hours) **[Total Marks: 80]**

N.B.

1. Question No. 1 is Compulsory.
2. Attempt any **Three** Questions from remaining **Five** Questions
3. Assume Suitable Data if needed and Justify the Same
4. Figures to the right indicate full marks.

Q.1:Write short notes on:

a. Manufacture of Biodiesel **[05]**

b. Differentiate between Catalytic reforming and catalytic cracking based on objective, process conditions and product span **[05]**

c. Hydrogenation of oil **[05]**

d. Manufacture of soap **[05]**

Q.2:

a. Describe manufacture of single superphosphate along with chemical reactions involved in it. What are the byproducts generated? **[10]**

b. Explain the manufacture process of Nitric acid by oxidation of ammonia and also explain the process design modification. **[10]**

Q.3

a. Explain the fermentation process to manufacture alcohol and also explain the inversion of sugar **[10]**

b. Explain the manufacture of Hydrochloric Acid by combustion of chlorine and hydrogen. **[10]**

Q.4

a. Discuss the manufacture process of styrene by dehydrogenation of ethylbenzene **[10]**

b. Discuss the manufacture process of Phenol from cumene by peroxidation-hydrolysis process **[10]**

Q.5

a. Explain the LDPE manufacturing by Ziegler Process. **[10]**

b. Describe the manufacturing process used for synthesis of BTX. **[10]**

Q.6

a. Describe major engineering problems in manufacture of caustic soda. **[05]**

b. Describe major engineering problems in manufacture of urea. **[05]**

c. What are the different by-products obtained during manufacture of sugar and explain its utilization? **[05]**

d. Define the detergents and give the constituent of the commercial detergents **[05]**

SE | Chemical | ~~Sem-III~~ Sem-IV | ~~CBGS~~ | Choice Based | 4/12/2019

[3 Hours] [Marks : 80]

Please check whether you have got the right question paper.

N.B:
1. Question No. 1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Figures to the right side indicate full marks.
4. Non-programmable calculator is allowed.

1. (a) Show that $\int_c \log z \, dz = 2\pi i$, where C is the unit circle in the z-plane. **05**

(b) Find the fourier series for $f(x) = 1-x^2$ in $(-1, 1)$ **05**

(c) Prove that $\left(\frac{E^4-1}{\Delta}\right) y_0 = y_0 + y_1 + y_2 + y_3$ **05**

(d) Show that the set of functions $\sin(2n+1)x$, $n = 0, 1, 2, \ldots$ is orthogonal on $\left(0, \pi/2\right)$. **05**

2. (a) Find the Fourier expansion for $f(x) = \sqrt{1-\cos x}$ in $(0, 2\pi)$. **06**

(b) Find the relative maximum or minimum of the function. **06**

$z = x_1^2 + x_2^2 + x_3^2 - 6x_1 - 10x_2 - 14x_3 + 103$

(c) Obtain Taylor's or Laurent's series for the function **08**

$f(z) = \frac{1}{(1+z^2)(z+2)}$ for (i) $1 < |z| < 2$ (ii) $|z| > 2$

3. (a) Find the missing entries in the following table : **06**

X	0	1	2	3	4	5
Y	1	----	11	19	----	41

(b) Solve the partial differential equation **06**

$3x\frac{\partial z}{\partial x} - 5y\frac{\partial z}{\partial y} = 0$ by the method of separation of variables.

(c) Using the Kuhn-Tucker conditions, solve the following NLPP. **08**

Maximise $z = x_1^2 + x_2^2$

Subject to $x_1 + x_2 - 4 \leq 0$

$2x_1 + x_2 - 5 \leq 0$

$x_1, x_2 \geq 0$

4. (a) Obtain half-range cosine series of $f(x) = lx - x^2$, $0 < x < l$ **06**

(b) Evaluate $\oint_c \frac{\sin^6 z}{\left(z-\pi/2\right)^3} dz$ where c is $|z| = 2$ **06**

(c) A string is stretched and fastened to two points distance l apart. Motion is started by displacing the string in the form of $y = a\sin\left(\frac{\pi x}{l}\right)$ from which it is released at time t = 0. Show *l* that the displacement of a point at a distance x from one end at time t is given by $y(x,t) = a\sin\left(\pi x/l\right)\cos\left(\pi ct/l\right)$ **08**

5. (a) If f(1) = 5 , f(3) = 9, f(5) = 13 , f(7) = 15 find f(2) using Lagrange's interpolation formula. **06**

(b) Obtain complex form of Fourier Series for $f(x) = e^{ax}$ in (0, a) **06**

(c) Determine the solution of one-dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the boundary conditions $u(0,t) = 0, u(l,t) = 0, u(x,0) = x, (0 < x < l)$ l being length of the rod. **08**

6. (a) Using Cauchy's residue theorem evaluate $\int_c \frac{z^2}{(z-1)^2(z-2)} dz$ where c is the circle $|z|$=2.5 **06**

(b) Using the method of Lagrange's multipliers, solve the following N.L.P.P. **06**

Optimise $z = 2x_1 + 6x_2 - x_1^2 - x_2^2 + 14$

subject to $x_1 + x_2 = 4$

$x_1, x_2 \geq 0$

(c) From following data find f (6) using Newton's divided differences. **08**

x:	3	7	9	10
f(x):	168	120	72	63

9/12/2019

SE I chemical Sem -IV| choice based

[Time: Three Hours] [Marks:80]

Please check whether you have got the right question paper.

N.B: 1. Question No.1 is compulsory.
2. Attempt any three questions from Q. No.2 to Q. No.6.

Q.1 Answer any four of the following. **20**

a) Explain how HPLC and paper chromatography are similar. Give any two applications of HPLC.
b) Explain with example catalytic poisoning and catalytic promoters.
c) Explain Ketoenol tautomerism with example.
d) Explain the separation of Lanthanides by ion exchange method.
e) State Huckels rule and explain the Aromaticity of pyrrole.
f) Explain the Debye Huckel theory of strong electrolytes.
g) Define and explain the electrophoresis as electrokinetic phenomenon.

Q.2 a) Explain Donan membrane equilibrium with its significance. **05**
b) Explain the effect of dilution and temperature on conductance. **05**
c) What is meant by Flipping of protons and precessional frequency of Nucleus in NMR spectroscopy? Explain in detail. **05**
d) Explain the role of complexing agents in solvent extraction. **05**

Q.3 a) Explain the concept of electrical double layer using Helmholtz and stern model. **05**
b) Write the syathesis of following compounds from acetoacetic ester **05**
i. Adipic acid ii) cyclobutane carboxylic acid
c) The distribution ratio of I_2 between CCl_4 and H_2O is 80 in favour of CCl_4 50 ml of an aqueous solution (1.45×10^{-3} m) is equilibrated with 30 ml portion of CCl_4. Calculate the amount of I_2 left unextracted for single and double extraction. **05**
d) Describe the working of flame photometer. **05**

Q.4 a) Define and explain the mechanism of Benzil Benzilic acid rearrangement. **05**
b) What are the advantages and limitations of conductometric titrations? **05**
c) Describe the mechanism of Acid-base catalyzed reaction. **05**
d) Define aromaticity and explain the structure and bonding of Napthalene. **05**

Q.5 a) Define activation energy and explain the adsorption theory of catalysis. **05**
b) How would you prepare the following compounds from diethyl malonate. **05**
i) Succinic acid ii) Barbituric acid
c) What are the advantages of potentometric titrations? Give its limitations. **05**
d) Predict for sample $CH_3OC_2H_5$ and CH_3CH_2OH **05**
i) The no. of peaks
ii) The splitting

Q.6 a) 100 cm^3 of an aqueous solution containing 0.200gm of a solute was shaken with 50cm^3 of organic solvent. If the distribution ratio $D_{o/w} = 120$. Calculate the amount of solute unextracted and the % of extraction. **05**
b) Write the mechanism and applications of Reformatsky reaction. **05**
c) Compare between UV and IR spectroscopy. **05**
d) Write a short note on transport number. **05**

SE CHEM SEM IV CHOICE BASED 11/12/2019

(3 Hours) [Total Marks : 80]

N.B. (1) Question No 1 is compulsory
(2) Attempt any three questions out of remaining five questions
(3) Assumption made, if any should be clearly stated
(4) Figures to the right indicate full marks.

Q 1 Explain any four **20**

(a) State Raoult's law .Show that it is simplified form of Lewis Randall Rule
(b) Concept of Phase Equilibria
(c) Chemical Potential
(d) Effect of Temperature on equilibrium Constant
(e) Coefficient of Performance and Refrigerator capacity

Q 2 (a) Derive Gibbs Dehum Equation and check whether these equation satisfy the Gibbs-Duhem equation or not **12**

The activity coefficient data for a binary solution at constant T and P are correlated by the relation

$\ln \gamma_1 = x_2^2 (0.5 + 2x_1)$ $\ln \gamma_2 = x_1^2(1.5 - 2x_2)$

(b) Explain Phase rule and Determine the number of degrees of freedom in a gaseous system consisting of H_2O, HCl, O_2 and Cl_2 **08**

Q 3 (a) The following simultaneous reaction take place in a gas mixture **10**

$A+B \rightarrow C + D \quad K_1 = 0.1429$

$A+C \rightarrow D + E \quad K_2 = 2$

Calculate the equilibrium composition at 1 bar if an equimolar mixture of A and B is fed to a reactor to produce D. Assume that the reaction mixture behaves like an ideal gas

(b) Explain vapour absorption refrigeration system with principle. **10**

Q 4 (a) The volume of a solution prepared from MgSO4 and 1 kg of water varies with molality (moles solute per kg of solvent) according to the expression **10**

$V = 1.00121 \times 10^{-3} + 34.09 \times 10^{-6} (m-0.070)^2$

Where m is the molality of the solution in mol/kg and V is the volume in m3. Calculate the partial molar volume of the salt and solvent when m = 0.05 mol/kg

(b) Define excess property and Property change of Mixing and show that the property change of mixing and excess properties are identical. **10**

Q 5 **(a)** At a pressure of 101.3 kPa , ethyl acetate (1) and ethyl alcohol(2) form an azeotrope containing 53.90 mole %ethyl acetate at 345 K **12**

i) Determine the van Laar constants

ii) Determine the composition of the vapour in equilibrium with a liquid of composition 60 mole % alcohol and 40 % acetate and boiling at a temperature of 329.5 K.

Data : The vapour pressure of ethyl acetate and ethyl alcohol **at 345 K** are 84.77 kPa and 78.24 kPa

The vapour pressure of ethyl acetate and ethyl alcohol **at 329.5 K** are 47.98 kPa and 39.72 kPa

(b) What are azeotropes? Explain in brief maximum and minimum boiling Azeotropes. **08**

Q 6 **(a)** A refrigerating unit using Freon -12 as the working fluid operates between 18^0C and 37^0C. The rate of circulation of refrigerant is 2 kg/min and the efficiency of the compressor is 0.85. Using the following data of enthalpy, calculate **10**

i) The capacity of the plant in tons of refrigeration

ii) The power required to run the unit

iii) The COP of the unit

Data : The enthalpies of R-12 liquid at 37^0C is 455 kJ/kg. The enthalpies of R-12 entering and leaving the compressor are 563.15 kJ/kg and 595.4 kJ/kg respectively.

(b) Calculate the Gibbs free energy change and equilibrium constant at 700 K for the ammonia synthesis reaction $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ **10**

The standared heat of formation and standared free energy of ammonia at 298 K are -46100 and -16500 J/mol respectively

C_P^0 Data : $N_2 : 27.27 + 4.93 \times 10^{-3} T$

$H_2 : 27.01 + 3.51 \times 10^{-3} T$

$NH_3 : 29.75 + 25.11 \times 10^{-3} T$

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5 + 10 =

S.E. (Chemical Engg.) Sem-IV Choice Base 13/12/2019

[Time: 3 Hours] [Marks: 80]

Please check whether you have got the right question paper.

N.B:
1. **Question no.1 is compulsory**
2. **Attempt any three from remaining five questions**
3. **Assume suitable data if required.**
4. **Figure to the right indicates full marks.**

Q. 1 A) Explain in brief different particle size measurement techniques **(05)**
B) Write short note on Muller Mixer. **(05)**
C) Write short note on Elutriation. **(05)**
D) What is minimum fluidization velocity? **(05)**

Q. 2 A) If crushing rolls, 1 m in diameter, are set so that the crushing surfaces are 12.5 mm apart and the angle of nip is 31°, what is the maximum size of particle which should be fed to the rolls? If the actual capacity of the machine is 12 % of the theoretical, calculate the throughput in Kg/sec when running at 2.0 Hz if the working face of the roll is 0.4 m long and the bulk density of the feed is 2500 kg/m3 **(10)**
B) Derive the expression for screen effectiveness **(10)**

Q. 3 A) A slurry containing 5 kg of water/ kg of solid is to be thickened to a sludge containing 1.5 kg of water/ kg of solids in a continuous operation. A laboratory test using five different concentrations of slurry yielded the following results: **(10)**

Conc. (Kg water/kg of solid)	5.0	4.2	3.7	3.1	2.5
Rate of Sedimentation (mm/sec)	0.20	0.12	0.094	0.070	0.052

Calculate the minimum area of the thickener to effect the separation of 1.33 kg/s of solids.

B) Discuss constant pressure filtration and constant rate filtration. **(10)**

Q. 4 A) Derive the expression to estimate the size of smallest particle that can be separated in Cyclone separator. **(10)**
B) Discuss conditions for Fluidization in details. **(10)**

Q. 5 A) Discuss Blake Jaw Crusher in detail **(10)**
B) A sample of pyrite was screened. The screen analysis is given below. **(10)**
i. Calculate the mean surface diameter. Specific Gravity of pyrite is 5.0
ii. Find specific surface

Mesh	8/10	10/14	14/20	20/28	28/35	38/48	48/65
Mass fraction retained	0	21.2	19.6	17.4	14	15.8	12
Aperture, mm	1.651	1.168	0.833	0.589	0.417	0.295	0.208

Q. 6 A) Write short note on: i) Bag Filter ii) Belt conveyor **(10)**

B) The performance of the solid mixer has been assessed by calculating the variance occurring in weight fractions of a component amongst a selection of samples withdrawn from mixture. The quality was tested at intervals of 320 sec and the results are: **(10)**

Sample variance	0.025	0.006	0.015	0.019
Mixing Time	30	60	90	150

If the component analysed is estimated to represent 20% of the mixture by weight and each sample removed contained 100 particles. Comment on the quality of the mixture produced and present the data in graphical form showing variation and mixing index with time

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17/12/2019

Paper / Subject Code: 40305 / Mechamcal Equipment Design (MED)

S.E (Chem) sem-IV choice base Dec.2019

(4 hours) Marks: 80

N.B

1. **Question No. 1** is compulsory.
2. Attempt any **three** out of remaining **four** questions.
3. Assume any suitable data if necessary and indicate it clearly.
4. Figures to the right indicate marks.
5. Illustrate answers with sketches wherever required.

1. Write short notes on any **four.** 20

   a) Types of heads.

   b) Mechanical Seals.

   c) Heating and cooling systems in reaction vessel.

   d) Theories of failure.

   e) Supporting structures for pipelines.

2. a) Design a pressure vessel for the following specifications: 15

   i) Shell

   Internal Diameter = 1000 mm

   Material = Carbon steel (IS 2002)-(CS)

   Permissible stress for CS at 150^0 C = 140 N/mm^2

   Design pressure = 0.5 N/mm^2

   ii) Head (Standard Torispherical)

   Crown Radius = 1000 mm

   Knuckle radius = 6 % of Crown radius

   Material = Carbon steel (IS 2002)-(CS)

   Permissible stress for CS at 150^0 C = 140 N/mm^2

   iii) Flange, Gasket and bolt data:

   Gasket factor = 3.75

   Minimum design gasket seating stress = 52.5 N/mm^2

   Flange material is same as shell material.

   Permissible stress for bolt material = 138 N/mm^2

   Bolt size M 20 x 2 with root area = 200 mm^2

   Design should consist of the following:

   i) Shell ii) Head and iii) Flanges

b) Draw to recommended scale, the above designed cylindrical pressure vessel. 05

3. a) Write a design procedure for agitator vessel which includes: 15

i) Agitator shaft ii) Blade assembly iii) Stuffing box

b) Draw a proportionate drawing of stuffing box. 05

4. a) A cylindrical storage tank with open top has the following data : 14

Tank Diameter = 9 m

Tank Height = 7.5 m

Material of construction = Carbon Steel (IS : 2002- Grade 2B)

Density of Liquid = 0.001 kg/cm^3

Permissible stress = 120 N/mm^2

Design: 1 Shell plate thickness at various height

2 Wind girder.

(Use standard plate size as 1500 mm (width) x 5000 (length)

Standard curb angle of 75 x 75 x 6 mm size with sectional modulus 36.3 cm^3)

b) Draw to recommended scale, the above designed storage tank. 06

5. a) Describe the design procedure for reaction vessel with- 15

i) Plain Jacket

ii) Half Coil Jacket

iii) Channel Jacket

b) Draw to recommended scale, the above designed jackets. 05

6. Write short notes on any **four.** 20

a) Standards, codes and their significance.

b) Losses in storage of volatile liquid.

c) Nozzles.

d) Various metal forming techniques.

e) Types of gaskets.

SE/CH/ sem-IV / choice base. 19/12/2019.

Duration: 3 hours **Total Marks: 80**

N. B. (i) Question number **one is compulsory.**
(ii) Answer any **Three**questions from the rest.
(iii) Assume suitable data wherever necessary.

Q.1 Solve the following (**any four**): **[20]**

a) Explain the basic principle of Economy.

b) Differentiate between Scrap value and salvage value.

c) Write any four factors that affecting investment & production cost.

d) What is Net present value? Explain with suitable example.

e) Describe the general outlines of accounting procedure.

Q.2 a) A bond has a maturity value of \$1000 & is paying discrete compound interest at an effective annual rate of 3%. Determine the following at a time four years before the bond maturity value.

b) Present worth b) Discount c) Discrete compound rate of effective interest which will be received by the purchaser, if the bond were obtained at \$700 d) What will be the present worth if the nominal bond interest is 3% compounded continuously **[10]**

b) A new piece of completely installed equipment costs \$ 12000 & will have a scrap value of \$ 2000 at the end of its useful life. If the useful life period is 10 years & the interest is compounded at 6% per year. What is the capitalized cost of the equipment? **[10]**

Q.3 A material testing machine was purchased for Rs. 200000 & was to be used for 5 years with an expected residual salvage value of Rs. 5000. Calculate the depreciation & year-end book values by using: **[20]**

i) Straight Line Method

ii) Declining Balance Method

iii) Sum Of The Year Digit Method

iv) Sinking Fund Method

4 a) A bond has maturity value of Rs 1, 00,000/- & is paying discrete compound interest at an effective annual rate of 12 %. Determine the following at a time four years before the bond maturity value. (1) Present worth (2) Discount (3) Discrete compound rate of effective interest which will be received by the purchaser, if the bond were obtained at Rs 70000/- (4) What will be the present worth if the nominal bond interest is 12% compounded continuously. **[10]**

b) Explain Break-even analysis with graph. Derive relation for Break Even Point (BEP). **[10]**

5. a) A company offering an easy installment option while selling a equipment worth Rs. 3,00,000/- at a time of purchase Rs. 60000/- in cash & the remaining amount in 30 equal monthly installments, of Rs. 10000/-each. A bank also willing to pay 75% of the equipment cost & recovers it in 30 equal installments of Rs.8500/-each. Which potion is better? Why? **[10]**

b) Explain cash flow in chemical industries with suitable diagram. **[10]**

6. Write a short note on **[20]**

1) Rate of return. ii) Profitability iii) Self Insurance. iv) Annuity

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15/11/19

TE/CHEM/SEM V/CBCS

(3 Hours) [Total Marks: 80]

N.B.

1. Question No. 1 is Compulsory.
2. Attempt any **Three** Questions from remaining **Five** Questions
3. Assume Suitable Data if needed and Justify the Same
4. Figures to the right indicate full marks.

Q.1

a) What are different conditional Loop in Python? Explain any one with example **[05]**

b) Use secant method to find the root of equation $f=4(x-1)^3$ with $0.4 \leq x \leq 1$. **[05]**

c) Write short note on Successive Substitution Method **[05]**

d) Solve $\frac{dy}{dx} = \frac{1}{2}xy$, y(0)=1, y(0.1)=1.01, y(0.2)= 1.022, y(0.3)=1.023 and h=0.1 find the value of $y(0.4)_p$ and $y(0.4)_c$ by Adam-Bashforth Method **[05]**

Q.2

a) The spherical storage tank containing oil has a diameter of 6 ft. Calculate the height h to which a dipstick 8 ft long would be wet with oil when immersed in the tank when it contains 4 ft^3 of oil. The equation that gives the height, h, of the liquid in the spherical tank for the given volume and radius is given by $V = \frac{3\pi h^2(3r-h)}{9}$, Use the Bisection Method to find the height (h), to which the dipstick is wet with oil. **[10]**

b) Write a short note on one dimensional steady state diffusion with example. **[10]**

Q.3

a) Solve the following system by LU decomposition **[10]**

$$\begin{bmatrix} 1 & -1 & 2 \\ 2 & -2 & 3 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -8 \\ -20 \\ -2 \end{bmatrix}$$

b) Solve the following systems of equations by Gauss Jorden Method **[10]**

$5x_1+2x_2+x_3=12$, $x_1+4x_2+2x_3=15$, $x_1+2x_2+5x_3=20$

Q.4

a) if, $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$, y(0)=1,h=0.2 find y(0.4)=? **[10]**

By using runge kutta order 4 method

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b) Calculate the volume of superheated steam at 100atm and 350 ^{0}C using the equation [10]

$\left(P + \frac{a}{v^2}\right)(v - b) = RT$, Newton Raphson Method, for initial value of v use ideal gas equation.

where, $a = \frac{27R^2T_c^2}{64P_c}$, $b = \frac{RT_c}{8P_c}$, T_C=647.11K, P_c=220.76 atm.

Q.5

a) Define diffrence equation and Solve the following Diffrence Equation [10]

$y_{n+2} - 3y_{n+1} + 2y_n = 3^n + 7^n$

b) Solve the following set of equations using Newton method [10]

$x_1^2 + x_2^2 - 17 = 0$

$2x_1^{1/3} + x_2^{1/2} - 4 = 0$

Start at a value of x=[2.5 0.2]^T and show two iterations.

Q.6

a) A volume and level in gravity flow tank system is given by following equations, [20]

$\frac{dV}{dt} = 0.0107h - 0.00205V^2$ $\frac{dh}{dt} = 0.311 - 0.062V$

Where,

V in cu. ft and h in ft and time in sec.

The parameters and variables are given as given below.

V= tank volume ,(at t=0, 3.4 cu.ft.)

h= lavel in tank, (at t=0, 20.5 ft.)

Find the level and volume after 60 Sec using Runge kutta fourth order method. Use 20 sec as step size.

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40 + 27 + 10 = 77

TE (I) (CBCS) (Chem.) 19/11/19

[Time: 3 Hours] [Total Marks: 80]

Instructions to the candidates if any: -

1. Question No 1 is compulsory
2. Attempt any three questions from the remaining five questions
3. Assume suitable data wherever necessary
4. Figures to the right indicates full marks

Q. No. 1

a. Derive relation between $K - type$ and $F - type$ mass transfer coefficients for equimolal counter diffusion of gas A and gas B, when the driving force is partial pressure difference **[05]**

b. A thin film of liquid is flowing past a vertical surface, inclined at an angle of 38^O with the vertical. The density of the liquid is $994\ kg/m^3$, viscosity is $8.94 \times 10^{-2}\ kg/ms$. The thickness of the liquid film is $2.25\ mm$. Find the bulk average velocity with which the film is coming down. **[05]**

c. In a mixture of benzene vapor and nitrogen gas at a total pressure of $850\ mm\ of\ Hg$ and a temperature of $60^O C$, the partial pressure of benzene is $120\ mm\ of\ Hg$. Calculate mass and molal absolute humidity. **[05]**

d. Discuss the requirements for a solvent that can be used in gas absorption **[05]**

Q. No. 2

a. Derive the equation for calculating steady state molar flux for equimolar counter diffusion of gas A and gas B. **[08]**

b. Ammonia is diffusing through a stagnant gas mixture consisting of two third nitrogen and one third of hydrogen by volume. The total pressure is $2\ atm$ absolute and the temperature is $53^O C$. Calculate the rate of diffusion of ammonia through a film of gas, $0.6\ mm$ thick when the concentration change across the film is 12 % to 6 % by volume.
The given data is: -
Diffusivity of ammonia in nitrogen is $0.196\ cm^2/s$.
Diffusivity of ammonia in hydrogen is $0.63\ cm^2/s$. **[08]**

c. Write a short note on Height Equivalent to a Theoretical Plate **[04]**

Q. No. 3

a. Derive an equation between overall and individual mass transfer coefficients in interphase mass transfer between a gas and a liquid. **[10]**

b. The air pressure in a tyre reduces from $2\ bar$ to $1.98\ bar$ in four days. The volume of the air in the tube is $0.025\ m^3$, the surface area is $0.5\ m^2$ and the wall thickness is $0.01\ m$. The solubility of air in the rubber is $0.07 m^3/m^3$. Estimate the diffusivity of air in the rubber at $30^O C$. **[10]**

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Q. No. 4

a. Derive the equation for adiabatic saturation curves [08]

b. 6000 kg/hr of a $SO_2 - air$ mixture containing 4 % by volume of SO_2 is to be scrubbed with 150000 kg/hr of water in a packed tower. The exit concentration of SO_2 is reduced to 0.18 %. The tower operates at 1 atm. The equilibrium relationship is $Y = 29X$. If the packed height of tower is 400 cm, estimate the height of transfer unit. X and Y are the mole ratios in liquid and gas phase respectively. [12]

Q. No. 5

a. Discuss the comparison between packed and tray towers. [08]

b. A batch of solids for which the following table of data applies is to be dried from 28 % to 8 % moisture content under conditions identical to those for which the data was collected. The initial weight of the wet solid is 350 kg and the drying surface is $1m^2/$ 9 $kg\ dry\ weight$. Determine the time of drying. [12]

X	0.35	0.25	0.20	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.064
N	0.35	0.35	0.35	0.3	0.26	0.239	0.20	0.18	0.15	0.097	0.07

Q. No. 6 [20]

Write a short note on the following **[Any four]**

a. Diffusion through crystalline solids.

b. Problems associated with operation of a packed column.

c. Classification of cooling towers.

d. Two film theory

e. Diffusion coefficients for liquids.

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21/11/19

TE/CHEM/SEM V/ Choice based

(Time: 3 Hours) **Maximum Marks: 80**

N.B
1. **Question No. 1** is compulsory.
2. Attempt any **three** out of remaining **four** questions.
3. Make Suitable Assumptions if necessary and state them clearly.
4. Figures to the right indicate marks.
5. Illustrate answers with sketches wherever required.

Q1		Answer all.	
	a)	Describe radiation shield.	4
	b)	Explain Prandtl's theory of Boundary layer-	4
	c)	Explain Boling point elevation in Evaporation.	4
	d)	Calculate the heat loss by radiation from a steam pipe at 377K to air at 283K.The pipe O.D is 50mm. Emissivity=0.9.	4
	e)	Write about Critical and optimum thickness of insulation for pipes.	4
Q2	a)	A long aluminium pipe of 100cm diameter at 773K is exposed to air at 373K. Find the time required for the pipe to attain a temperature of 473K. Data: density=2700kg/m^3, Cp=896J/kgK, k=204 W/mK, h=80 W/m^{2}K.	8
	b)	A tube of 60mm OD is insulated with 50mm of silica foam (k=0.055W/mK) followed by 40mm layer of cork (k=0.05W/mK).The temperature at the tube surface is 400K and at the outer surface of the cork is 303 K. Find the Heat loss per metre of the tube.	8
	c)	Write Stephan Boltzmann law and Planks law for Heat transfer by radiation.	4
Q3	a)	Apply Ryleigh's method of dimensional analysis, to get rate of heat transfer in Forced convection.	10
	b)	Derive the relation between Effectiveness and NTU, for cocurrent flow in DPHE.	10
Q4	a)	Explain the various methods of feeding in multiple effect evaporators	6
	b)	Describe the construction, working& applications of Shell & tube heat exchangers.	10
	c)	Write about heat transfer in jacketed vessels.	4

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Q5 a) A cocurrent cooler is used to cool Oil at 420K to 370K, using water at 285K.The outlet temperature of water is 310K.By lengthening the cooler, the exit temperature of Oil is reduced to 350K, which changes the outlet temperature of water. If the flow rates, properties are kept the same, What is the new length of the cooler, assuming original length as 1 metre? **10**

b) An aluminium rod 25mm in diameter and 100mm long protrudes from a wall, at a temperature 525K into the environment at 288K. Find the heat lost, considering insulated end. Also find the efficiency and temperature at the end of the fin. **10**

Data: k=200W/mK. h=15W/m^2K

Q6 a) Explain the various stages in pool boiling. **10**

b) 100 tubes of O.D 12mm are arranged horizontally in a square array to condense steam at 1 atmosphere. Find the condensation rate if the tube wall temperature is 371K. **10**

Properties of steam at 372K (mean temp.) are $\rho = 960$ kg/m^3 k = 0.68 W/mK. Viscosity = 282*10^{-6} kg/ms. Latent Heat of condensation=2257kJ/kg.

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25/11/19

TE/SEM V / Chem / Choice Base

N.B.: (3 Hours) [Total Marks: 80]

(i) Question No.1. is compulsory.
(ii) Attempt any three questions out of remaining five questions.
(iii) Assume suitable data and justify the same.
(iv) Figures to the right indicate full marks

Q 1 (a) Explain Differential method of analysis of kinetic data **05**
(b) Explain molecularity and order of reaction **05**
(c) Derive performance equation of Batch reactor **05**
(d) Compute K_y at 10 atm if K_p at this pressure is 0.00381 atm^{-2} for the ammonia synthesis reaction from hydrogen and nitrogen at 500 ^{0}C. (Assume that ideal gas law is applicable) **05**

Q 2 (a) For the gas phase decomposition of azomethane $(CH_3)_2N_2 \rightarrow C_2H_6 + N_2$ with a rate expression $-r_{N_2} = \frac{K_1[C_{AZO}{}^2]}{1+K'C_{AZO}}$ where AZO = azomethane. Devise a mechanism to explain this rate **10**

(b) The gaseous reaction $2A \rightarrow R + 2S$ is second order with respect to A. If pure A is introduced at 1atm into a constant volume batch reactor, the pressure rises by 40 % in 3 minutes. In case of a constant pressure batch reactor find i) the time required to achieve the same conversion and ii) the fractional increase in volume at that time. **10**

Q 3 (a) A specific enzyme E acts as a catalyst in the fermentation of substrate A (the reactant). At a given enzyme concentration in the aqueous feed stream of 25 l/min. Find the volume of plug flow reactor required to achieve 95 % conversion of reactant A (C_{A0} = 2 mol/l).The kinetics and stoichiometry of the fermentation reaction are given by **10**

$$A \xrightarrow{enzyme} R \qquad -r_A = \frac{0.10C_A}{1+0.5C_A}\ mol/(l.min)$$

(b) A kinetic study of decomposition of acetaldehyde at 518^{0}C and 1 atm pressure is made in a flow reactor. The decomposition proceeds as per the reaction **10**

$CH_3CHO \rightarrow CH_4 + CO$

Acetaldehyde is boiled in a flask and passed through a reaction tube maintained at 518^{0}C by a surrounding furnace. The reaction tube has a inside diameter of 33 mm and length 800 mm. The flow rate through the tube is varied by changing the boiling rate. Analysis of the product stream leaving the tube is given below. Find a rate equation which will satisfactorily fit the data

Rate of flow of acetaldehyde, g/h	130	50	21	10.8
Fraction of acetaldehyde decomposed	0.06	0.13	0.24	0.35

Q4 (a) The Kinetics of the liquid phase decomposition of A is studied in two mixed flow reactors in series, the second unit having twice the volume of the first one. At steady state with a feed with C_{A0} = 1 mol/l and mean residence time of 96 sec in the first reactor, the concentration of A in the first unit (reactor) is 0.5 mol/lit and in the second is 0.25 mol/lit. Find the rate equation for the decomposition of A **10**

(b) Nitrous oxide decomposes according to the second order rate equation 10
$2N_2O \rightarrow 2N_2 + O_2$ The reaction rate constant is 977 cm^3 /mol.sec at 895 ^0C . Calculate the fraction decomposed at 1 sec, 10 sec and at 10 min in a constant volume batch reactor. The initial pressure (all N2O) is 1 atm.

Q 5 (a) Reactant A decomposes as follows 15

$$A \rightarrow R$$

$$A \rightarrow S$$

$$A \rightarrow T$$

The rate equations are $r_R = 1$, $r_S = 2\ C_A$ and $r_T = C_A^2$

Determine the maximum concentration of desired product that can be obtained i) in a mixed flow reactor and ii) in a plug flow reactor for R is the desired product and $C_{A0} = 2$

(b) A common rule of temperature is that the rate of a reaction doubles for each 10^0C rise in temperature. What activation energy would this suggest at a temperature of 25^0C. 05

Q 6 (a) The elementary irreversible liquid phase reaction A+B → C is carried out in a mixed flow reactor. An equimolar feed in A and B enters the reactor at 200 K(27^0C) and the volumetric flow rate is 2 lit/s. Calculate the volume of reactor to achieve 85 % conversion when the reaction is carried out adiabatically. 12

Data : ΔH^0_f for A = -20 kcal/mol, ΔH^0_f for B = -15 kcal/mol and ΔH^0_f for C = -41 kcal/mol

$C_{A0} = 0.10$ kmol/m^3, $C_{P_A} = C_{P_B} = 15$ cal/(mol.K), $C_{P_C} = 30$ cal/(mol.K)

k= 0.01 (lit/mol.sec) at 300 K, E = 10000 cal/mol

(b) The standard heat of gas phase reaction at 25^0C (298K) 08
A + B → 2R is $\Delta H^0_{R(298K)} = -50000$ J indicating that the reaction is strongly exothermic. It is planned to run this reaction at 1000 ^0C . What is the value of heat of reaction at this temperature ? Is this reaction is exothermic at 1000^0C?
Data : The mean /average C_P values between 25^0C and 1000^0C for the various reaction components/participants are

$\bar{C}_{P_A} = 35\ J/molK$

$\bar{C}_{P_B} = 45\ J/molK$

$\bar{C}_{P_R} = 70\ J/molK$

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27-11-2019

T.E. / chemical / choice based / Sem - V

(3 Hours) [Total Marks – 80]

N.B – (1) Question no 1 is compulsory.
(2) Solve any three questions from remaining five questions.
(3) Assume suitable data if necessary.
(4) Illustrate the answer with proper and neat diagram Wherever necessary.

Q.1	a)	What is shape memory alloy.	**5**
	b)	Types of stainless steel	**5**
	c)	Write application of carbon nanotubes.	**5**
	d)	Application of ceramic composite	**5**
Q.2	a)	What are conducting polymers? Explain several ways by which conductivity is induced in the polymers.	**10**
	b)	Explain Ferroelectric behavior of ceramics	**10**
Q.3	a)	What is high temperature polymers? Explain several ways by which heat stability of the polymer can be increased	**10**
	b)	State various methods for preparation of metal matrix composites and explain any one in details.	**10**
Q.4	a)	Explain diffusion bonding method for fabrication of metal matrix composites.	**10**
	b)	Explain various types of Thermal Spraying methods use for thin film coating.	**10**
Q.5	a)	Explain silicon nitride processing of ceramics.	**10**
	b)	Explain the mechanism by which high strength and creep resistance are achieved in Co based alloys.	**10**
Q.6	a)	Write short note on nanoshells and nanosensor	**10**
	b)	What do you mean by close moulding process? Write different close moulding processes. Explain in details pulforming process	**10**

TE| chemical | Sem – VI | choice Base 3/12/2019

Time: 3 Hrs. Marks: 80

N.B: (1) Question 1 is compulsory

(2) Answer any Three from remaining five questions.

(3) Assume suitable data whenever necessary.

(4) Figures to the right indicate full marks.

Q1. Attempt the following. (20)

1. What is air dispersion?
2. Noise Pollution
3. Biodiversity
4. The green Revolution.

Q2.a. Water pollutants are classified? List the major water pollutants, explain any one in detail. (10)

b. Describe Solid Waste Disposal methods. Explain any one in detail. (10)

Q3.a. Discuss the Activated Sludge Process waste water treatment. (10)

b. Explain in brief BOD test carried out in Laboratory scale. (10)

Q4.a. What is DO Sag-Curve? Explain in brief. (10)

b. Write & explain classification air pollution particulate matter in brief. (10)

Q5.a. Write a note on (10)

i. The Forest Conservation Act of1980.

ii. Ozone layer depletion.

b. Draw and explain working principle and construction of Fabric filters. (10)

Q6.a. Discuss the classification of hazardous waste based on material properties. (10)

b. Explain the effects of acid rain on human as well as on environment. (10)

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5/12/2019

TE| Chemical| Sem-VI| Choice Based

[3 Hours] [Total Marks: 80]

(1) Q.1 is compulsory. (2) Attempt any 3 from the remaining 5 questions. (3) Use graph paper, if required. (4) Assume suitable data if required and justify the same.

1 a Derive operating line equation for flash distillation. **5**

b What you mean by super saturation **5**

c Differentiate between physical adsorption and chemisorptions. **5**

d Explain industrial applications of leaching. **5**

2 a Explain Ponchon Savarit method for multistage tray towers. **10**

b A feed consisting of 1200 gram moles of mixture containing 30 percent naphthalene and 70 percent dipropylene glycol is differentially distilled at 100 mm Hg pressure and final distilled contains 55 percent of feed solution. Determine the amount of distillate and concentration of naphthalene in residue and distillate. VLE data is given below in percent **10**

X	8.4	11.6	28	50.6	68.7	80.6	88
y	22.3	41.1	62.9	74.8	80.2	84.4	88

3 a Explain factors involved in choice of solvent in extraction **10**

b Acetone is to be recovered from an aqueous solution containing 20 percent acetone by means of kerosene as solvent. The distribution of acetone in water and kerosene follows relationship X= 6.45Y. X= kg acetone/kg water, Y= Kg acetone/kg kerosene. If 6 kg/kg solution of kerosene is used in tower, Find number of equilibrium stages required to reduce the concentration from 0.20 to 0.040 in aqueous flow. Kerosene and water are nearly immiscible. All compositions are by weight. **10**

4. a) Nitrogen gas contaminated with water at 926 mg/kg N_2 is continuously fed to pilot scale adsorption column that contains a 0.268 m high bed packed with molecular sieve. Out let data given below **10**

Time hrs	0	9	9.2	9.6	10	10.4	10.8	11.25	11.5	12	12.5	12.8
Water conc. (mg/kg N2)	0	0.6	2.6	21	91	235	418	630	717	855	906	926

If the breakthrough curve is defined here as being when C/C_0 reaches 0.02, (a) Find breakthrough time(b)Fraction of total sieve capacity used by breakthrough time.

b) Draw and explain breakthrough concentration profile in fluid at outlet of the adsorption bed. Describe the method for determination of capacity of column from breakthrough curve. **10**

5 a) Explain various properties of a membrane that affect separation. **5**

b) Explain various methods of super saturation. **5**

c) A salt solution weighing 10,000 kg with 30 wt. percent Na_2CO_3 is cooled to 293K. The salt crystallizes the decahydrate. What will be the yield of $Na_2CO_3 .10H_2O$ crystals if the solubility is 21.5 kg unhydrous Na_2CO_3 per 100 kg water. For (a)No water evaporated(b) 3 percent of total weight of solution is lost by evaporation of water in cooling. **10**

6. Write short notes **20**

a Tray efficiency

b Principles of leaching operation

c Pressure swing adsorption

d Osmotic equilibrium in reverse osmosis processes

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TE CHEM SEM VI CHOICE BASED 10/12/2019

(3 Hours) [Total Marks : 80

N.B.
1) Question 1 is compulsory.
2) Attempt 3 questions out of remaining 5 questions.
3) Assume data whenever necessary.
4) Figures to the right indicate full marks.

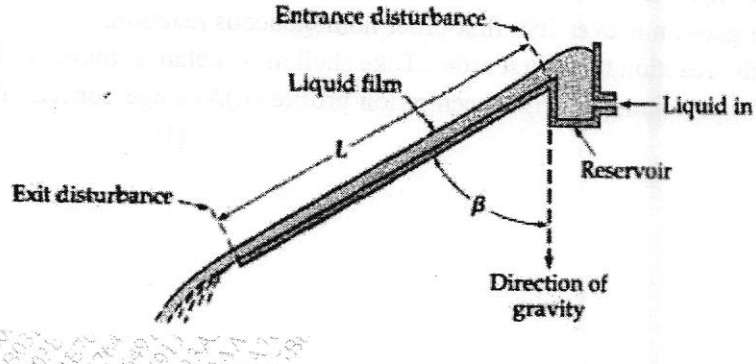
Q1: Write short notes on: (20)

i) Describe similarity between Fick's law, Fourier's law and Newton's law.
ii) Explain temperature and pressure dependence of thermal conductivity.
iii) What are commonly used boundary conditions used for finding constants of integration in shell energy balances?
iv) Explain rules for writing shell mass balances.

Q.2. (a): Starting from basic principles, develop equation of continuity for isothermal,incompressible fluid flow system .Can equation of continuity be applied to nuclear reactions? (10)

(b) Find the radius of capillary tube from following data:
1) Length of capillary tube :50.02 cm
2) Kinematic viscosity of liquid :4.03 x 10^{-5} Pa
3) Density of liquid :0.9552 x 10^{3} kg/m^{3}
4) Pressure drop in horizontal tube :4.829 x 10^{-5} Pa
5) Mass flow flow flow through tube : 2.997 x 10^{-3} kg/s (10)

Q.3. (a):A Newtonian,incompressible fluid is flowing over a inclined flat plate of length L and width W.Take a shell momentum balance and derive equation for
(i) Shear stress distribution (ii) Velocity distribution
(iii) Average velocity (iv) Maximum velocity (16)



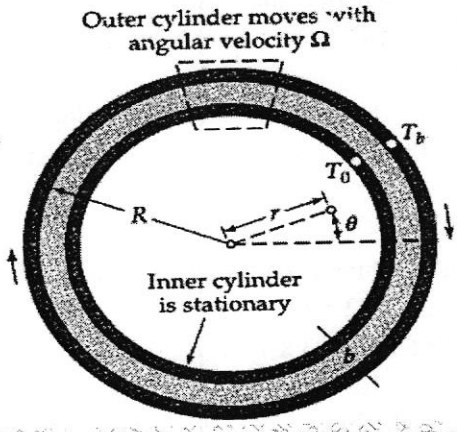
(b) Estimate thermal conductivity of molecular oxygen at 300 K and low pressure. Following data is given. (04)

Molecular weight – 32 $\sigma(^0 A) = 3.433$

$\varepsilon/k = 113$ K $\Omega = 1.074$

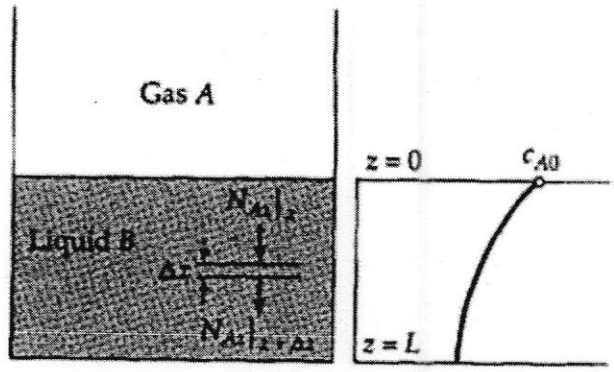
Cp - 7.019 cal/ gmole.K Use Eucken approximation .

Q.4. (a): Consider the flow of an incompressible Newtonian fluid between two coaxial cylinders . The surfaces of the inner and outer cylinders are maintained at T = To and T = Tb, respectively. As the outer cylinder rotates, each cylindrical shell of fluid "rubs" against an adjacent shell of fluid. This friction between adjacent layers of the fluid produces heat due to "viscous dissipation". Derive equation for temperature gradient. Make suitable assumptions.(15)



(b) A pipe with inside diameter 2.067 inch and wall thickness of 0.154 inch carrying steam is insulated with 2 inch of 85% magnesia covered in turn with 2 inch cork.Estimate the amount of heat loss per hour per foot of pipe if inner surface of pipe is at 250 F(121.11 ^{0} C) and outer surface of cork is at 90 F(32.22^{0}C). The thermal conductivities (in Btu/hr.ft.F) of substance concerned are : k of steel = 26.1 & k of 85% magnesia = 0.04 & k of cork = 0.03 (05)

Q.5.(a) Gas A dissolves in liquid B in a beaker and diffuses isothermally into the liquid phase. As it diffuses, A also undergoes an irreversible first-order homogeneous reaction: A + B gives AB. Assume the reaction to be first order. Take shell mass balance, make suitable assumptions and find out expressions for: (i)Concentration profile (ii)Average concentration in the liquid phase. (16)



(b) An oil is flowing down a vertical plate as a film 1.7 mm thick. The oil density is 820 kg /m^3 and viscosity is 0.20 Pa.s.Calculate Γ(mass flow rate per unit width of wall) and reynolds number. Also calculate average velocity. (04)

Q.6. (a) Estimate cD_{AB} for the system CO-CO_2 at 296.1 K and 1 atm total pressure (10)

$a = 2.754 \times 10^{-4}$ $b = 1.823$

Label	Gas	M	T(K)	Pc(atm)
A	CO	28.01	133	34.5
B	CO_2	44.01	304.2	72.9

(b) An electric current with current density I amp/cm^2 is flowing through an electric wire of circular cross section with radius R and electrical conductivity ke(ohm^{-1} cm^{-1}). The rate of heat production per unit volume is given by the expression $Se = I^2/ke$

The quantity Se is the heat source resulting from electrical dissipation. The surface of the wire is maintained at temperature To. Take shell energy balance and find expression for

(Heat flux distribution)

(ii) Temperature distribution

(iii)Maximum temperature rise

(iv)Average temperature rise (10)

T.E. (Chemical Engg.) Sem-VI Choice Base 12/12/2019

(3 Hours) [Total Marks: 80]

N.B. (1) Question No.1 is compulsory.
(2) Attempt any **three** questions from remaining.
(3) Assume suitable data wherever necessary with proper justification

Q.1 a) The Thiele modulus for a first order isothermal reaction for a flat plate geometry catalyst is found to be 2. Calculate the catalyst effectiveness factor. **(05)**

b) Calculate the time required for complete burning of particles of graphite (size: Ro= 5 mm, density: $\rho_B = 2.2$ gm/cm^3) in an 8 % oxygen stream at 900 deg C and 1 atm. For the high gas velocity assume that film diffusion does not offer any resistance to transfer and reaction. Rate constant : k" = 20 cm/sec **(05)**

c) Sketch the concentration profile for fluid fluid reaction if it is slow reaction (Assume reaction is between gaseous A and liquid B. Show the concentration profile for 1) High C_B 2) Low C_B **(05)**

d) A liquid macrofluid ,as it flows through a vessel , reacts as per following reaction and kinetics: **(05)**
$A \rightarrow R$ $-r_A = k$ mol/l min; k=3 mol/l min and C_{A0}= 6 mol/l
For the flow pattern with E=0.333 for 0<t< 3 min, determine the conversion of A.

Q.2. Develop Langmuir-Hinshelwood type of rate equation for **(20)**

$$P + Q \rightleftarrows R + S$$

a) When the rate of desorption of R is rate controlling step.
b) When the surface reaction between Adsorbed P and gaseous Q is rate controlling step.

Q.3 a) In a fluidized bed reactor, particles of iron sulphide of uniform size are to be roasted. The time required for complete conversion is 20 min. The mean residence time of particles in the fluidized bed is 60 min. the particles remained as hard solids during reaction. The time required for complete conversion is a function of size of particle ($\tau \alpha R^{1.5}$). Calculate the fraction of the original iron sulphide that remains unreacted. **(10)**

b) Develop conversion time relationship for spherical particles of unchanging size using Shrinking core model for the case when chemical reaction step is offering controlling resistance. **(10)**

Q.4. We plan to remove 90% of the reactant A present in a gas stream by absorption in pure water in a packed tower. Find the volume of tower required for countercurrent operation. **(20)**
For the gas stream : Fg = 9 x10^4 mol/h at $\pi = 10^5$ Pa
$p_{A\,in}$ =1000 Pa, p_{Aout} =100 Pa
For liquid stream : $F_l = 9x10^5$ mol/h
For the packing used
$k_{Ag}.a = 0.36$ mol / (h.m^3.pa); $k_{Al}.a = 72$ h^{-1}
The molar density of liquid under all conditions is
C_T= 55556 mol/m^3
k = 0 m^3 liquid / (mol.h); H_A=18 (Pa.m^3 liquid) / mol

Q.5.a) A first order decomposition reaction where k= 0.05 min^{-1} was carried out in a reactor with a number of dividing baffles .The results of tracer test are given in table below **(20)**

t, min	0	10	20	30	40	50	60	70
C_{pulse}, g/l (tracer output concentration)	35	38	40	40	39	37	36	35

i) Calculate mean residence time
ii) Estimate the conversion assuming a) plug flow ; b) mixed flow
iii) How many tanks in series would you suggest to model this reactor.

Q.6.a) Oxidation of NO is catalyzed by an active carbon according to following rate: **(10)**

$$-r' = \frac{p_{NO}^2 \cdot p_{O2}}{a + b\,p_{NO}^2 + c\,p_{NO2}} \left(\frac{mol}{h.g\ cat}\right)$$

$a = 1.619 \times 10^{-4}$, $b = 4.812$, $c = 1.352 \times 10^{-3}$
p = partial pressure in atm
Find the volume of a reactor for converting 50 metric tonnes per day of NO to NO_2 when using an air-No mixture containing 15 mole % of NO. The conversion of No is 90%. The bulk specific gravity of catalyst is 0.48 and the total pressure is 3 atm.

b) Write short note on Slurry Reactor **(10)**

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03 + 10 = 13

TE chem sem-VI 16/12/19

[Time: 3 Hours] [Marks:80]

Please check whether you have got the right question paper.

N.B:
1. Question No.1 is compulsory.
2. Attempt any **Three** out of remaining questions.
3. Assume any suitable data if necessary and indicate it clearly.
4. Draw neat sketches wherever required.
5. Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.
6. Steam Tables can be referred.

Q.1 a Draw fire triangle and describe it. 5

b A process has a report FAR of 2.If an employee works a standard of 8-hr shift 300 days per year, compute the death per person per year. 5

c Write note on Detonation and Deflagration. 5

d Give classification of Boilers. 5

Q.2 a Xylene is used as a solvent in paint. A certain painting operation evaporates an estimated 3 gal of xylene in an 8-hr shift. The ventilation quality is rated as average. Determine the quantity of dilution ventilation air required to maintain the xylene concentration below 100 ppm, the TLV-TWA. Also, compute the air required if the operation is carried out in an enclosed hood with an opening of 50 ft^2 and a face velocity of 100 ft./min. The temperature is 77°F and the pressure is 1 atm. The specific gravity of the xylene is 0.864, and its molecular weight is 106. k = 0.125. 10

b Write on disaster of Pasadena Texas from the perspective of Technical Failures and Consequences with the help of proper diagram. 10

Q.3 a Explain MSDS covering contents of it. 8

b What are the LFL and UFL of a gas mixture composed of 0.8 % hexane (LFL = 1.2 % and UFL = 7.5 %) , 2.0 % methane (LFL = 5.0 % and UFL = 15 %) and 0.5 % ethylene (LFL = 2.7 % and UFL = 36 %) by volume. 6

c Air contains 5 ppm of diethyl amine (TLV-TWA of 5 ppm), 20 ppm of cyclohexanol (TLV-TWA of 50 ppm) and 10 ppm of propylene oxide (TLV-TWA of 2 ppm). What is the TLV-TWA of mixture and has this level been exceeded? 6

Q.4 a Describe how HAZOP is carried out. Write its checklist. 10

b Describe Even tree and Fault tree analysis with one example each. 10

Q.5 a Exhaust steam at a pressure of 0.5 bar and 0.8 dry enters a surface condenser, the water resulting from the condensation leaves the condenser at a temperature of 56 ^{0}C. Assuming that all the heat lost by steam is taken up by the cooling water, find the heat removed from the steam per kg and also the mass of cooling water required per kg of steam, if the temperature rise of cooling water is 28 ^{0}C. Take specific heat of water as 4.187 kJ/kg K. 6

b Explain various applications of air in chemical plant. 6

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c Explain with proper diagram: - Distribution of steam in plant. 8

Q.6 a Derive the formula for minimum work per kg of air delivered by multistage compressor with perfect intercooling 10

b A single stage double acting air compressor of 62.5 kW I. P. at 120 r.p.m. takes air at 1 bar and delivers at 10 bar. Assuming the law of and compression as $pv^{1.35}$ = constant, find the diameter and stroke of the cylinder. Take piston speed = 200 m/min, Volumetric efficiency = 90 %. Also find the clearance volume as percentage of stroke volume. 10

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2+10

BE (CHEM) (Choice Based) 14/11/2019

Duration: 3 hours Total Marks: 80

N. B. (i) Question number one is compulsory.
(ii) Answer any three questions from the rest.
(ii) Assume suitable data wherever necessary.

Q. 1 Write short note on any four 20

(a) tall column internals

(b) Theories of failure

(c) types of high pressure vessel

(d) Types of heat exchanger

(e) Types of packings

Q. 2 Design a U-tube heat exchanger for the following data-

a) Data --

(i) Shell Side:-

No. of shells – 1, No. of passes – 1,
Fluid – Water, Design Pressure – 0.45N/mm^2
M.O.C. – Carbon Steel,
Permissible stress for C.S. – 100N/mm^2
Standard torrispherical head with knuckle radius as 6% of crown radius
25%cut segmental baffles with tie rods and spacers
M.O.C. for head and all flanges- Carbon steel
Gasket on shell side – Flat metal jacketed asbestos filled
Gasket factor – 3.75, Gasket seating stress -53N/mm^2

(ii) Tube Side:-

Tube and tube sheet material – S.S., No. of tubes – 60
Outside diameter – 20mm, Pitch (Δ^{lar}) – 30mm
Fluid – Carbon Dioxide, Design Pressure – 1.5N/mm^2
Permissible stress for S.S. – 105N/mm^2

(iii) Channel and Channel Cover:-

Material of construction – same as shell
Joint with tube sheet – Ring Facing,
Gasket – Steel jacketed asbestos Gasket factor – 5.5,
Gasket seating stress – 126N/mm^2

Design should include-

(a) Shell, 06
(b) Head, 02
(c) Flange joint between shell and tube sheet, 06
(d) Tube sheet thickness, 03
(e) Channel and Channel cover 03

Q. 3 Design a Standard Vertical Short Tube Evaporator for the following Data –

Evaporator drum under vacuum – external pressure = 0.12N/mm^2
Amount of water to be evaporated = 24,500 N/hr
Heating surface area = 240m^2,
Steam Pressure = 0.12 N/mm^2

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Density of Liquid = 9800 N/mm^3,
Density of Vapor = 0.86 N/mm^3
M.O.C. = Low Carbon Steel,
Permissible Stress for Low Carbon Steel = 100 N/mm^2
E for L.C.S. = 20×10^4 N/mm^2,
E for Brass = 9.6×10^4 N/mm^2
Tube Material = Brass,
O.D. of Tube = 80mm,
Tube Thickness = 1.8mm
Effective length of Tube = 1195mm,
Pitch of tube (Δ^{lar}) = 120mm
Conical heads at top and bottom cone angle = 120^0
Bottom Flange of Calendria: -
Thickness of Flange = 46mm — No. of bolts = 120,
P.C.D. = 4250mm, — Size of bolts = 20mm dia,
Factor of safety = 3
Design should include-

(a) Diameter of tube sheet, 04
(b) Calendria sheet thickness, 04
(c) Tube sheet thickness, 04
(d) Evaporator drum thickness and diameter, 06
(f) Head thickness 02

Q. 4 (a) Explain the design procedure for shell wall of a tall column. Design procedure should incoroporate calculation of all the stresses acting on the shell. 12

(b) Draw neat diagram of distillation column with internals 8

Q. 5 A high pressure compound cylinder consist of an inner tube of inner diameter 200 mm and O.D. 250 mm all it is shrunk fit or tube of external dia. 300 mm. The shrink fit so alone that the contact pressure at the two tubes surfaces do not exceed 7.85MPa. The cylinder is then subjected to an internal pressure of 83MPa. Calculate original dimensions of tubes and plot the stress distribution diagram. If coefficient of thermal expansion is 12×10^{-6}/°C. Calculate by what temperature the outer tube should be heated to achieve the necessary shrink fit. Assume E(Modulus of elasticity) = 200×10^3 N/mm^2. Also find reduction in maximum stress by compounding when compared to a single tube of I.D. 300 mm. 10

Data:

D1 = 200 mm — D2 = 250 mm
D3 = 300 mm — Pi = 83 MPa
Pf = 7.85 MPa — E = 200×10^3 N/mm^2
α = 12×10^{-6} / °C — t =? (temp. difference)
stress distribution =?

To calculate original dimensions of tube so, as to develop a contact pressure of 7.85 N/mm^2. (Calculation of deformation of tube).

Q. 6

(a) State Different NDT techniques. Explain ant two in detail. 10

(b) Write notes on: - 1) PFD 2) PID 10

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BE (Chem. Engg.) (VII) (Choice based)
18/11/2019

(3 Hours)

[Total Marks: 80]

N.B.: (1) Question No.1 is compulsory.
(2) Attempt any **Three** out of remaining questions.
(3) Assume any suitable data if necessary and indicate it clearly.
(4) Draw neat sketches wherever required.
(5) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.

Q.1. (a) Describe criteria of selection between tray tower and packed tower. **(05)**

(b) Explain the characteristics of process flow diagram. **(05)**

(c) Draw and explain the onion diagram representing hierarchy of chemical process design. **(05)**

(d) What are the basic functions of process engineer? **(05)**

Q.2. (a) Benzene at 37.8^0 C is pumped through the system at a rate of 9.09 m^3/h with the help of Centrifugal pump. The reservoir is at atmospheric pressure. Pressure at the end of discharge line is 345 Kpa g. The discharge head is 3.05 m and the pump suction head is 1.22 m above the level of liquid in reservoir. The friction loss in suction line is 3.45 kPa and that in the discharge line is 37.9 kPa. The mechanical efficiency of the pump is 0.6. The density of benzene is 865 Kg/m^3 and its vapour pressure at 37.8 ^{0}C is 26.2 kPa. Calculate: **(12)**
(i) $(NPSH)_A$ of the pump
(ii) Power required by centrifugal pump

(b) The fluid density is 1200 kg/m^3 and is being pumped at the rate of 800 m^3/day. The inlet and exit pressures for the pump are 300 and 600 kPa respectively. The efficiency of pump and associated motor are 75% and 85% respectively. Then calculate, break horse power of the pump and its bare module cost in present year. **(08)**
Data: C_o = Rs. 45000; S_o = 2000 watt; α = 0.36; F_m = 1; F_o = 1.5; **MF** = 3.38; **CI** in present year = 1200; **CI** in base year = 390

Q.3. (a) Design an orifice meter based on the following data: **(12)**
Name of fluid = water; Flow rate= 100000 kg/h;
β = 0.5; Y = expansion factor for liquid = 1; $L_1 = L_2 = 1$;
Inside diameter of pipe = 154 mm
Operating temp 32 ^{O}C
Density of water at 32 ^{O}C = 995.026 kg/m^3
Viscosity of water at 32 ^{O}C = 0.765 cP
Manometric fluid = Mercury
Density of mercury at 32 ^{O}C = 13516.47 kg/m^3.

(b) Explain catalyst degradation process in detail. **(08)**

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Q.4. (a) A distillation column is to separate 4750 mol/h of feed composed of 37% n-butane, 32% iso-pentane, 21% n- pentane and 10% n-hexane. The column operates at an average pressure of 2 atm a and will produce a distillate product containing 95 % n- butane and 5% iso pentane. The bottom product is allowed to contain no more than 570 mol/h of n- butane. Feed is 25% vapour. Assume ideal vapour liquid equilibrium. All compositions are mole %. Find: **(12)**

(i) Residue and distillate compositions

(ii) q (Feed at 25% vap)

(iii)Use Underwoods method to determine the minimum reflux for required separation

Data: v (constant used in Underwood equation) = 1.6045

	n-butane	iso pentane
α_{av}	2.567	1

(b) Explain common types of reactor configuration. **(08)**

Q.5. (a) Explain design and working of short path distillation unit along with its application **(12)**

(b) Explain role and responsibilities of process and chemical engineering profession towards society, and environment along with its ethical aspects and safety concerns. **(08)**

Q.6. Explain the following **(any four)**

(a) Sizing of compressor and turbine **(05)**

(b) Algorithm for Design of Absorber **(05)**

(c) Product life cycle **(05)**

(d) Equation of bare module cost of an equipment **(05)**

(e) Optimum pipe size **(05)**

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 20/11/19

BE (Chemical) Sem - VII choice based

(3 Hours) Total Marks: 80

N.B:

1) Question 1 is compulsory. Answer any three questions from the remaining.
2) Assume data if necessary and specify the assumptions clearly
3) Draw neat sketches wherever required
4) Answer to the sub-questions of an individual question should be grouped and written together.

Q.1.

a) A process of unknown transfer function is subjected to a unit impulse input. The output of the process is measured accurately and is found to be represented by the function $y(t) = te^{-t}$. Determine the unit step response of this process [05]

b) Explain Phase Margin and Gain Margin? [05]

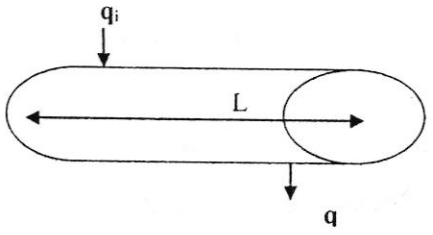
c) A second order system is found to have a peak amplitude ratio of 1.1547 at a frequency of 0.7071 *rad/min.* What are the values of natural period of oscillation and the damping coefficient of the system? [05]

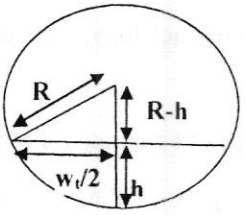
d) Write the degree of freedom equation and discuss the conditions to specify the process model. [05]

Q.2.

a) A horizontal cylindrical tank shown in Figure.A below is used to slow the propagation of liquid flow surges in a processing line. Figure.B illustrates an end view of the tank and w_t is the width of the liquid surface, which is a function of its height, both of which can vary with time. The model equation for the height of liquid h in the tank at any time with the inlet and outlet volumetric flow rates is given below. Linearize the given model equation assuming that the process initially is at steady state and that the liquid density ρ is constant.

$$\frac{dh}{dt} = \frac{q_i}{2L\sqrt{(D-h)h}} - \frac{C_v h^{0.5}}{2L\sqrt{(D-h)h}}$$





Derive the transfer function relating the changes in the liquid level **h** to the changes in the inlet flow rate q_i outlet flow rate is q. The Radius of cylinder is R and diameter of the tank is D, L is the length of cylinder and C_v is the constant of the valve in the outlet line. [10]

b) Two streams w_1 and w_2 each at a constant density of 900 kg/m^3, and carrying solute of mass fraction x_1 and x_2 respectively, enter a continuous stirred tank of 2m^3 capacity. At steady-state, w_{1s}=500 kg/min, w_{2s}=200 kg/min, x_{1s}=0.4, and x_{2s}=0.75. Suddenly the inlet flow rate w_2 decreases to 100 kg/min and remains there. Determine an expression for the mass fraction of the solute $x(t)$. Assume that liquid hold up is constant. [10]

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Q.3.

a) The dynamic behaviour of a pressure sensor/transmitter can be expressed as a first-order transfer function (in deviation variables) that relates the measured value P_m to the actual pressure, P:

$$\frac{P_m(s)}{P(s)} = \frac{1}{30\,s + 1}$$

Both $P_m(s)$ and $P(s)$ have units of psi and the time constant has units of seconds. Suppose that an alarm will sound if P_m exceeds 45 psi. If the process is initially at steady state, and then P step changes from 35 to 50 psi at 1:10PM, at what time will the alarm sound? [10]

b) The dynamic behaviour of the liquid level in each leg of a manometer tube, responding to a change in pressure, is given by where $h(t)$ is the level of fluid measured with respect to the initial steady-state value, $p(t)$ is the pressure change, and R, L, g, ρ, and μ are constants.

$$\frac{d^2h}{dt^2} + \frac{6\mu}{R^2\rho}\frac{dh}{dt} + \frac{3}{2}\frac{g}{L}h = \frac{3}{4\rho L}p(t)$$

(i) Rearrange this equation into standard gain-time constant form and find expressions for K, τ and ξ in terms of the physical constants.

(ii) For what values of the physical constants does the manometer response oscillate?

(iii) Would changing the manometer fluid so that ρ (density) is larger make its response more oscillatory, or less? [10]

Q.4.

a) Consider the following transfer function of a process: [10]

$$G_p(s) = \frac{5e^{-0.2s}}{(2s^2 + s + 1)}$$

Design a PI controller for the negative feedback loop of the process, based on the Zeigler and Nicholos tuning rules?

b) A first order process is controlled with a PI controller. For the system under study assume that $G_p(s) = G_d(s) = \frac{1}{s+3}$ and $G_m(s) = G_f(s) = 1$. Find the values of the controller gain K_c and reset time τ_I that can satisfy, if possible, the below conditions:

(i) The decay ratio of the closed loop response is equal to 0.25

(ii) The closed loop gain to load changes is 10 [10]

Q.5.a) Using Routh Criteria determine the positive limits of K_c for the stability of the system with following open loop transfer function. $G_{OL}(s) = \frac{K_c(s+1)}{(s^4 + 2s^3 + 2s^2 + (3 + K_c)s + K_c)}$

(i) with K=6, will the output response be stable? [05]

(ii) Determine the limiting positive values of K for stability? [05]

Q.5.b) A unit feedback control system has: $G(s) = \frac{64(s+2)}{s(s+0.5)(s^2 + 3.2s + 64)}$ Generate Bode plot and comment on the stability. Find the gain margin and phase margin. [10]

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Q.6.

a) Following response was obtained from a dynamic system when a step of magnitude 0.2 was introduced.

Time(min)	Response
0	0.00
5	0.01757
10	0.025273
15	0.088674
20	0.178158
25	0.268563
30	0.343173
35	0.396964
40	0.432176
45	0.453617

Finally the response reaches a constant value of 0.4798 after a long time. Use the data to fit the First order plus dead time model to the system? [10]

b) Discuss Bode stability Criterion [5]

c) Differentiate between Negative and positive feedback control system [5]

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Paper / Subject Code: 41956 / Elective - III Petoleum Refining Technology (T.S) 22/11/17.

B.E / SEM VII / Chemical / Choice Base

(03 Hours) [Marks:80]

N. B.: (1) Question No. **1** is **Compulsory.**

(2) Attempt any **THREE** questions out of remaining **FIVE** questions.

(3) Figures to the **right** indicate **full** marks.

(4) Make **suitable** assumptions wherever **necessary.**

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1. (a) Define and explain the importance Octane number & Cetane number [05]

   (b) Differentiate between EFV and TBP distillation. [05]

   (c) Distinguish between Unisol & Dualayer process [05]

   (d) Give the composition of Asphalt? What is the action of heat on Asphalt? [05]

2. (a) Give different testing methods to test quality of kerosene. Explain any one method in short with suitable diagram. [10]

   (b) Explain different tower arrangements used in crude distillation operation [10]

3. (a) Explain Dehydration and desalting of crude in detail. [10]

   (b) Discuss in brief the process of furfural extraction for lubricating oil. What are the advantages of using furfural over phenol? [10]

4. (a) What the different type of Coking methods. Explain Flexi Coking in detail with a flow diagram. [10]

   (b) Explain the HF alkylation process with neat flow diagram. Explain how it differs from the sulphuric acid alkylation process [10]

5. (a) Explain Houndry flow catalytic cracking process in detail. [10]

   (b) Explain different types of Asphalt and explain air blowing of bitumen process. [10]

6. (a) Explain Hydro cracking process giving reactions, reaction conditions, feedstock and catalyst used. [10]

   (b) Explain MEK Dewaxing process with neat flow diagram.

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25-11-2019

BE/ chemical/ choice base/ sem - VII

3 hours 80 Marks

N. B.:

1. **Question no. 1 is compulsory**
2. Attempt any **THREE Questions** from remaining **FIVE** questions.
3. Use illustrative diagrams wherever required.

Q1) Attempt any **FOUR** questions.

a) Give any **TWO** examples of energy conservation and energy efficiency each. **05**

b) Define 1) Energy management 2) Energy audit, as per energy conservation act. **05**

c) List any **FIVE** ENCON (ENergy CONservation) opportunities possible in lighting system. **05**

d) List any **FIVE** thermal systems that require energy management practices on regular basis. **05**

e) Why it is necessary to conduct **on site** performance evaluation in energy auditing. **05**

Q2) a) Distinguish between 'preliminary energy audit' and 'detailed energy audit'. **10**

b) What are advantages of NPV method over Simple Payback Period method? Calculate net present value (NPV) for an investment towards a LED Lamp having life of 2 years. The discount rate is 10% per year. The cost of lamp is □400/_. Due to investment, annual savings in first year and second year is □1000/_ each. **10**

Q3) a) What are the benefits of Power Factor (PF) improvement? During June-2019, the plant has recorded a maximum demand of 600 kVA and average PF is observed to be 0.82 lag, the minimum average PF to be maintained is 0.92 lag as per the independent utility supplier and every one % dip in PF attracts a penalty of Rs 10,000/in each month. Calculate **new kVA and the improvement in PF** for July-2019 by installing 100 kVAr capacitors. **10**

b) How an "energy efficient motor" is different from a "standard motor" in construction aspects? What are the advantages of energy efficient motor on standard motor? **10**

Q4) a) Why dry saturated steam is preferred for heating applications? Name any **FIVE** characteristics of steam which makes it most popular and useful to industries? **10**

b) List any **TEN** ENCON (ENergy CONservation) opportunities possible in HVAC system. **10**

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Q5) a) XYZ company decided to replace 400 W lamp with 250 W lamp, 250 W lamp with 150 W lamp and 125 W lamp with 70 W lamps for same light output for 4500 hours of annual operation and consider Rs. 4.5 as per unit cost. Calculate **energy savings, cost savings and simple payback period** due to investment decision. **10**

b) The specifications of cooling water pump connected to boiler, are as follows: Discharge- Q = 12.5 lit/sec, head- H = 60m, Power consumption- P = 13.4 kW. As per the boiler manufacturer, required quality is 12.5 lit/sec at 3.0 kg/cm^2. What type of energy conservation measure can be proposed and estimate the **reduction in power consumption**? Assume operating efficiency of pump as 65% and motor efficiency as 90%. **10**

Q6) a) What do you mean by **ECBC**? Enlist any **FIVE** energy saving measures possible in any commercial building. **10**

b) What is LEED rating of a building? Discuss how any traditional building is converted into green building? **10**

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BE / Chemical / Sem - VIII / CBSGS 4/12/2019

Duration: 3 hours **Total Marks: 80**

N. B.: (1) Question No. **1** is **Compulsory.**
(2) Attempt any **THREE** questions out of remaining **FIVE** questions.
(3) Figures to the **right** indicate **full** marks.

1.	(a)	What is Project? Explain Characteristics of Project?	[05]
	(b)	Explain Qualities and Duties of PM	[05]
	(c)	Write note on Phases of Technologies Transfer (TT)	[05]
	(c)	Explain the concept of entrepreneur and entrepreneurship and management	[05]
2.	(a)	Explain project phases with the help of Project Life Cycle Curve.	[10]
	(b)	Explain the various types of Time Estimates in details.	[10]
3.	(a)	Explain ABC analysis in details	[10]
	(b)	Explain VED analysis.	[10]
4.	(a)	Explain GANTT chart with its advantages and disadvantages.	[10]
	(b)	Explain Seven 'C's for team building.	[10]
5.	(a)	Explain What is Startup and Stabilization, and and what is difference between them.	[10]
	(b)	Explain in brief examination process and procedure for Patent	[10]
6.	(a)	Explain in brief Classification & types of entrepreneurship depending on type of Business.	[10]
	(b)	Explain Concept, Object, and Basic functions of Management in detail.	[10]

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BE | Chemical | Sem - VIII | CBSGS

9/12/2019

Duration:-03 Hrs **Marks: 80**

N.B:-

1) Question **No 1** is compulsory
2) Attempt **any three** questions from the remaining **five** questions
3) Assume suitable data wherever necessary
4) Figures to the right indicate full marks.

Q.1] Write short notes **(any four)** 20
a) Carbon cycle
b) Microorganism growth kinetics
c) Trickling filter
d) Ozone Depletion
e) High Volume sampler.

Q.2] a) Discuss the various types of solid wastes. 10
b) Discuss in brief sludge treatment and disposal 10

Q.3] a) The following BOD results are observed for a sample of raw sewage at 20°C.

Time in Day (t)	0	1	2	3	4	5
BOD in mg/lit (y)	0	65	110	140	160	170

Calculate reaction rate constant and ultimate BOD. 10

b) Explain with neat sketch the function of Facultative pond. 10

Q.4] a) What is Noise Pollution? Explain its causes, consequences & abatement methods. 10
b) Explain with neat sketch the ventury scrubber . 10

Q.5] a) Explain in brief in effects of water pollutants on human health. 10
b) A chimney with design stack height of 250 m is emitting sulphur dioxide at a rate of 500 gm/sec on a sunny day in June with moderate wind speed at the stack altitude. Estimate the concentration of sulphur dioxide downwind for the following situation: 10
a) $<\rho so_2>$ {1000, 0, 0,250}
b) $<\rho so_2>$ {1000, 50, 0,250}
c) $<\rho so_2>$ {1000, 50, 20,250}
d) If $<\rho so_2>$ {1000,y ,0, 250} is 100 $\mu g/m^3$,what is the value of y in meters?

Given : A= 0.295 , B=0.119 ,p=0.986

Q.6] a) Explain DO Sag curve and Critical Oxygen deficit? 10
b) Discuss the design criteria for Activated Sludge Process in detail. Derive the necessary derivation for volume of Aeration tank. 10

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B.E. (Chem. Engg.) Sem- VIII CBSGS 13/12/2019

(3 Hours) [Total Marks 80]

Que. 1

a) Explain overall strategy for developing unit models [05]

b) List out the various methods of optimization and explain in brief. [05]

c) Derive the Fenske's equation for distillation column [05]

d) Explain in details (EOS) model. [05]

Que. 2

a) Derive fenske equation for minimum number of stages in distillation column. [10]

$$N_m = \frac{ln[(\xi_{lk}(1-\xi_{hk})/(\xi_{hk}(1-\xi_{lk})]}{ln\alpha_{lk/hk}}$$

b) 95 % acetone from air acetone vapour mixture is to be recovered by using absorption using water as a solvent at 300 K and 10 bar. The feed entering bottom of column consists of 12 moles of air and 1 mole of acetone. The operating pressure in column are 300 K and 10 bar respectively. The absorption factor for acetone is 1.4. calculate [10]

i) Required flow rate of solvent
ii) Number of stages
iii) Composition of leaving vapour and liquid from absorption column

Data given: Vapour pressure of acetone = 0.322 bar
Vapour pressure of water = 0.035 bar

Que. 3 Feed stream with pure species P and Q are mixed with recycle stream enter CSTR, where following reactions take place [20]

$$P + Q \rightarrow X$$
$$X + Q \rightarrow S + R$$
$$S + X \rightarrow Z$$

Here, X is an intermediate, S is main product, R is bi product and Z is oily waste. The plant consist of reactor, a heat exchanger to cool reactor effluent, a decanter to separate waste product Z from reactants and other products and a distillation column to separate product S. Due to formation of an azeotrope some of product (equivalent to 15 wt% of mass flow rate of component R) is retained in the column bottom. Most of the bottom product is recycled to reactor and rest is purged. Construct a Williams-otto flowsheet and develop the process equations.

Que. 4

a) Solve the following problem by Kuhn Tucker condition [10]

Maximize $Z = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$
Subject to $x_1 + x_2 \leq 2$
$2x_1 + 3x_2 \leq 12$ with $x_1, x_2 \geq 0$

b) Solve the fixed point problem given by [10]

$$x_1 = 1 - 0.5\exp(0.7(1 - x_2))$$
$$x_2 = 2 - 0.3\exp(0.5(x_1 + x_2))$$

Using direct substitution method starting from $x_1 = -1$ and $x_2 = -1$.

Que. 5

a) Consider the water gas reaction, [10]

$$CO + H_2O \leftrightarrow CO_2 + H_2$$

At a pressure of 5 atm and temperature of 600 K. What is the equilibrium concentration?

Given Data: The Gibbs energy of reaction

$$\Delta G_{f\,CO_2} = -94.26\ kcal/gmol \quad \Delta G_{f\,CO} = -32.81\ kcal/gmol$$
$$\Delta G_{f\,H_2O} = -54.64\ kcal/gmol \quad \Delta G_{f\,H_2} = 0\ kcal/gmol$$

b) Solve graphically the following problem (Lagrange multiplier) [10]

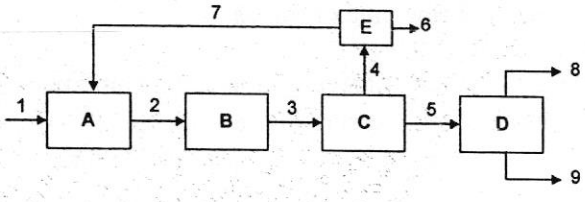
Maximize $z = 2x_1 + 3x_2$

Subject to ${x_1}^2 + {x_2}^2 \leq 20$

$x_1 x_2 \leq 8$ and $x_1, x_2 \geq 0$

Que. 6

a) Find the tear stream for the following system by BTA [10]



b) Explain model nonideal Flash Drum with neat sketch [10]

BE/CH/ sem- VIII / CBSGS 17/12/2019

(3 hour) [Total marks: 80]

N.B.:

1. Question No.1 is compulsory and attempt any four questions from remaining
2. Assume data if necessary and specify the assumptions clearly
3. Draw neat sketches wherever required

Q.1 [Compulsory Question]

a) Distinguish between Commercial, non-commercial energy sources [4]
b) Write short note on "Mini energy audit". [4]
c) What is pinch temperature? What is its significance? [4]
d) What is Cogeneration system? Give its advantages. [4]
e) Explain direct and indirect benefit of WHR [4]

Q.2

a) Explain Energy efficient technology with the help of any industrial process example. [5]

b) Determine the pinch temperature and the minimum utility requirement for the stream set out in the table below for a minimum temperature difference between the streams of 20 ^{0}C. Also Design a heat exchanger network to achieve the maximum heat recovery.

Stream Type	Stream No	Source Temperature ^{0}C	Target Temperature ^{0}C	Heat Capacity Rate (CP) W/^{0}C
Hot	H_1	440	150	2800
Hot	H_2	520	300	2380
Cold	C_1	100	430	1600
Cold	C_2	180	350	3270

[15]

Q.3

a) State energy policies and energy rules and regulations in India. [05]

b) A forward feed triple effect evaporator is used to concentrate dilute solution. The steam at 121^{0}C and 4093 kg/hr is used as heating source for Ist effect, however in 2nd and 3rd effect vapour generated in previous effect are used as heating source. The latent heat of steam used in 1st effect is 2200 KJ/Kg.

Calculate

1. Boiling Point in each effect
2. Heat transfer area in each effect and
3. steam economy

Data:

	Effect 1	**Effect 2**	**Effect 3**
U [W/m^2K]	3100	2000	1100
ΔT [^0C] adjusted for cold feed condition	18	17	34
Vapour Generated [Kg/hr]	2480	2660	2858
λ [Kg/KJ]	2249	2293	2377

[15]

Q.4

a) State Indian energy demand and supply. [5]

b) Determine the minimum hot and cold utility requirement and pinch temperature by using composite curve for the process stream having following thermal data

Stream No	**Stream Type**	**Source Temperature ^0C**	**Target Temperature ^0C**	**Heat Capacity Flowrate (CP) $W/^0C$**
1	Hot	180	80	20
2	Hot	130	40	40
3	Cold	60	100	80
4	Cold	30	120	36

[15]

Q.5

a) State and Explain the 'Heat Integration of MEE evaporator with GCC.
   1. Forward feed Triple effect evaporator.
   2. Backward feed Triple effect evaporator and
   3. Mixed feed Triple effect evaporator

[10]

b) Explain in detail the energy auditor tool box

[10]

Q.6. Write Short Note on any four of the following [20]

a) Composite Curve
b) Waste Heat Recovery Boiler
c) Bottoming Cycle of Cogeneration
d) Energy Profile
e) Fuel Cell
