Chemical Department

Bachelor Of Engineering

Question Papers May-June 2019

Sem III to VIII

SE (CH) (III) (Choice Based) 8th May 2019

(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) Find the Laplace Transformation of $e^{-2t}\sin 3t\cos 2t$ (5)

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

(c)A random variable X has following probability function (5)

X	1	2	3	4	5	6	7
P[X=x]	k	2k	3k	k^2	k^2+k	$2k^2$	$4k^2$

Find (i) value of k (ii) P[X < 5] (iii) P[X > 5] (iv) P[0 < X < 6]

(d) Find P such that $\frac{1}{2}\log(x^2+y^2) + i\tan^{-1}\left[\frac{Px}{y}\right]$ is analytic. (5)

2. (a) Prove that $\int_0^\infty e^{-t}\frac{\sin^2 t}{t}dt = \frac{1}{4}\log 5$ (6)

(b) The marks obtained by students in a college are normally distributed with mean 65 and variance 25. If 3 students are selected at random from this college, what is the probability that at least one of them would have scored more than 75 marks. (6)

(c)Find the analytic function f(z) = u+ iv s.t. $u - v = \frac{\sin x+\cos x-e^{-y}}{2\cos x-e^{y}-e^{-y}}$ when $f\left[\frac{\pi}{2}\right] = 0$. (8)

3. (a) A transmission channel has a per digit error probability p = 0.01. Calculate the Probability of more than one error in 10 received digit using (i) Binomial distribution (ii) Poison distribution. (6)

(b) Find the inverse Laplace Transformations of (i) $\frac{3+2s+s^2}{s^3}$ (ii) $\frac{s}{(s-1)(s-2)(s-3)}$ (6)

(c) Show that matrix $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ is diagonalizable. Find diagonal form D and diagonalising matrix M. (8)

4. (a) Seven dice are thrown 729 times. How many times do you except at least four dice to show three or five. (6)

(b) A random sample of 50 items gives mean 6.2 and standard deviation 10.24. Can it be regarded as drawn from a normal population with mean 5.4 at 5% LOS. (6)

(c) (i) Find the image of $|z - 3i| = 3$ under mapping $w = \frac{1}{z}$ (6)

(ii) Find the fixed points of $w = \frac{3z-4}{z-1}$ (2)

5. (a) Find the Eigen values and Eigen vectors of $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ (6)

(b)Theory predicts that proportion of beans in the four groups A,B,C,D should be 9: 3: 3: 1 in an experiment among 1600 beans, the numbers in the four groups 882, 313,287 and 118. Does the experiment results supports the theory. (6)

(c) Solve the differential equation $(D^2 - 3D + 2)y = 4\ e^{2t}$ given that $y(0) = -3$, $y'(0) = 5$. (8)

6. (a) Using convolution theorem find inverse Laplace transformation of $\frac{s^2}{(s^2+4)(s^2+25)}$ (6)

(b) Calculate the correlation of coefficient from the following data: (6)

X	23	27	28	29	30	31	33	35	36	39
Y	18	22	23	24	25	26	28	29	30	32

(c) Reduce the following quadratic form to canonical form. Also find its rank index and signature. $6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4zx$ (8)

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14/05/19.

S.E. (Chem) CBCGS (Choice Base) III Semester

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

N.B.: (1) Question no. 1 is compulsory.
(2) Attempt any three questions from remaining five questions.

1. Answer any four of the following. 20 M
   (a) Explain the structure of SF_4 on the basis of VSEPR Theory.
   (b) Write IUPAC names of the following co-ordination compounds-
   (i) $Na[Mn(CO)_5]$
   (ii) $[Ag(NH_3)_2]Cl$
   (c) Explain preparation, properties and bonding involved in $Fe(CO)_5$
   (d) Explain Thermodynamically and Kinetically controlled reactions. Hence, explain sulphonation of naphthalene.
   (e) Compare the stability of tertiarty, secondary and primary carbocation. Justify your answer using inductive effect and hyperconjugation.
   (f) What is photolysis? Explain Norrish type-I and Norrish type-II with mechanism.

2. (a) Define Quantum yield. Explain the reasons for high quantum yield. 5 M
   (b) Write the chemical formula of the following co-ordination compounds- 5 M
   (i) Tetracyanonickelate (II) ion
   (ii) Dichloro diammine platinum (II)
   (c) Explain mechanism and applications of Wohl-Ziegler bromination reaction. 5 M
   (d) Explain biochemistry of enzyme containing Zn. 5 M

3. (a) Draw molecular orbital diagram for F_2 molecule and comment on its bond order and magnetic properties. 5 M
   (b) What is EAN? Calculate EAN of $[Ni(CO)_4]$ 5 M
   (c) Explain the structure of carbenes. 5M
   (d) Draw Jablonski diagram to explain various modes by which an excited molecule gives out extra energy and comes to the ground state. 5M

4. (a) Discuss the formation of carbanion. 5M
   (b) What are the drawbacks of VBT? 5 M
   (c) What is CFSE? Calculate CFSE for high and low spin octahedral complexes. 5 M
   (d) Differentiate between Photochemical and Thermochemical reactions. 5 M

5. (a) Explain the mechanism of Pinacol-Pinacolone rearrangement reaction. 5 M
   (b) Explain oxygen atom transfer biomolecular reactions containing iron. 5 M
   (c) Compare Bonding and Antibonding molecular orbitals. 5 M
   (d) What are the drawbacks of CFT? 5 M

6. (a) On the basis of MOT, explain energy level diagram of NO molecule. 5 M
   (b) Give mechanism and applications of Reimer-Tiemann reaction. 5 M
   (c) Write a note on ionization isomerism and linkage isomerism. 5 M
   (d) Explain transition state and intermediate. 5 M

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SE (Chemical) / Sem - III / Chhoice based. 20/5/2019

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

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

Q1. Explain the following **(any four)** [20]
a. Write short note on surface tension and capillary effect.
b. State various pressure measuring devices.
c. Explain loss of head due to sudden contraction.
d. Explain the major and Minor losses in pipes
e. What do you mean by term fluid and give its classification.

Q2. (a) What is eddy viscosity? Indicate Relation betwee: eddy viscosity and eddy diffusivity of momentum. [10]
(b) Two horizontal plate are placed 1.25 cm apart ,the space between them being filled with oil of viscosity 14 Poise. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s. [10]

Q3. (a) 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]
(b) Draw and explain the propagation of pressure waves, when Ma = 1, Ma<1 and Ma>1 [10]

Q4. (a) What is eddy viscosity ? Indicate Relation between eddy viscosity and eddy diffusivity of momentum. [10]
(b) Explain and derive expression for Pitot-tube [10]

Q5. (a) Derive the expression for Vertical single column manometer. [10]
(b) Explain the characteristics curve of centrifugal pumps [10]

Q6 Explain the following terms **(any four)** [20]
a. Explain Pascal's law.
b. What is the significance of Mach No.? Also define Mach No
c. Derive an expression for hydrostatic equilibrium.
d. Write short note on Rota Meter .
e. NPSHR and NPSHA.

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S.E (chem) sem III choice based, 26/5/2019

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.

1. (a) Distinguish between reversible and irreversible processes by giving 2 examples of each. **05**
   (b) Derive an expression to estimate entropy change of an ideal gas. **05**
   (c) Explain the physical significance of the triple point and the critical point. **05**
   (d) What are the Maxwell's equations? **05**

2. One kmol of an ideal gas at 0.2 MPa and 500 K undergoes the following reversible changes: **20**
   (i) Compressed isothermally to 3 MPa.
   (ii) Cooled at constant pressure to 300 K.
   (iii) Expanded adiabatically to 1 MPa.
   (iv) Expanded isothermally to its initial pressure.
   (v) Heated isobarically to 500 K.

   Determine ΔU, ΔH, Q and W for the individual stage and for the entire cycle.
   Data:
   $C_p = 3.5\ R\ J/(mol.K)$, $C_v = 2.5\ R\ J/(mol.K)$

3. (a) A reversible heat engine operates with three reservoirs at 300 K, 400 K and 500 K. It absorbs 900 kJ energy as heat from the reservoir at 500 K and delivers 300 kJ work. Determine the heat interaction with other two reservoirs. **10**
   (b) Calculate the compressibility factor & molar volume for methanol vapor at 500 K & 10 bar by using pressure explicit form & volume explicit form of Virial Equation of State. **10**
   Data:
   $B = -2.19 \times 10^{-4}\ m^3/mol$ & $C = -1.73 \times 10^{-8}\ m^6/mol^2$ for methanol.

4. (a) Derive an expression for Joule Thomson inversion temperature for a gas obeying van der Waals equation of state in terms of reduced properties. **10**
   (b) Derive an expression for fugacity coefficient of ammonia vapor. Ammonia vapor obeys Redlich Kwong equation of state. **10**
   Redlich Kwong equation of state is given by:

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

Where:

$$a = 0.42748\frac{R^2T_c^{2.5}}{P_c} \quad \text{and} \quad b = 0.08664\frac{RT_c}{P_c}$$

5. (a) Explain and derive Exergy balance for a closed system. **10**
   (b) Calculate the enthalpy and entropy departures for ethane at 400 K and 1 MPa using van der Waals equation of state. **10**

Data:
$T_c = 305.43$ K, $P_c = 48.84$ bar, $V = 3.21 \times 10^{-3}$ m^3/mol

6. Write short notes on the following: **20**
   (i) Law of corresponding states
   (ii) Carnot principle
   (iii)Joule Thomson effect
   (iv)T-S diagram

SE (Chem) sem-III Choice Base 30/5/2019

Time: 3 Hours 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) Define the following:- Normality, specific gravity,adiabatic flame temperature,percentage excess and selectivity in chemical reaction 10

(b) 2000 ml solution of strength 0.5 N H_2SO_4 is to be prepared in laboratory by adding 98% H_2SO_4(sp.gr.1.84) to water. Calculate the volume in mL of 98% H_2SO_4 to be added to the solution of required strength. 10

2 (a) Fresh juice contains 15% solids and 85% water by weight and is to be concentrated to contain 40% solids by weight.In single evaporation system, it is found that volatile constituents of juice escape with water leaving the concentrated juice with a flat taste. In order to overcome this problem, part of the fresh juice bypasses the evaporator.Calculate: 10
(a) The fraction of juices that bypasses the evaporator.
(b) The concentrated juice produced (containing 40% solids) per 100kg of fresh juice fed to the process.

(b) 2000 kg of wet solids 70% solids by weight are fed to a tray of water where it is dried by hot air. The product finally obtained is found to contain 1% moist weight , calculate : 10
(a) The kg of water removed from wet solids.
(b) The kg of product obtained.

3 Monochloracetic acid ($CH_2ClCOOH$) is manufactured in a semi batch reactor by the action of glacial acetic acid (CH_3COOH) with chlorine (Cl_2) gas using a suitable catalyst at 373K(100^0C). 20
The reaction is $CH_3COOH + Cl_2 \rightarrow CH_2ClCOOH + HCl$
The chlorine used 15% (mole) in excess of that theoretically required. The reaction is 95% complete. During chlorination the liberated hydrochloric acid gas is scrubbed with water in order to obtain 20% (weight) hydrochloric acid solution. Calculate : (a) the raw materials required for 3000kg of monochloroacetic acid production per batch and (b) the amount of 20% (weight) HCl solution produced per batch.

4 (a) A gas mixture containing 15 mole % 'A' and 85 mole % insert's is fed to an absorption tower where it is contacted with liquid solvent 'B' which absorbs 'A'. The mole ratio of solvent to gas entering the tower is 2:1. The gas leaving the absorber contains 2.5% 'A', 1.5% 'B' and rest inerts on mole basis.Calculate: 10
(i) The percentage recovery of solute 'A'
(ii) The fraction of solvent 'B' fed to the tower lost in gas leaving the column (during the process some solvent evaporates and gets added in gas leaving the column).

(b) Draw the neat diagram of the following operations and write their respective material balance equations. Specify if there is a tie component in the operation. **10**
(i)Distillation (ii) Absorption (iii) Crystallization (iv)Extraction (v)Extraction

5 (a) In a laboratory, a steam boiler is fired with liquefied petroleum gas (it may be treated as pure n-butane). 100% excess air is used. The fuel and air enter the combustion chamber at 298 K. The flue gases leave the boiler at 523K. Determine the amount of energy transferred as heat in the boiler for 15 kg fuel. Assume complete combustion and insulating boiler. **20**

(i) The standard heat of combustion (net heating value) of n-butane is -2635.58 kJ/mol

(ii) The constants in the heat capacity equation are as given below

$c^0_p = a + bT + eT^{-2}$, kJ/kmol.K)

component	a	$b\times10^3$	$e\times10^{-5}$
CO_2	45.369	8.688	-9.619
O_2	30.255	4.207	-1.887
H_2O (g)	28.850	12.055	-1.066
N_2	27.270	4.930	0.333

6 a) Carbon monoxide at 1000 K is burned with air at 800 K. 90% excess air is used. The products of combustion leaves the reaction chamber at 1250 K. The standard heat of reaction at298K is -283.028kJ/mol CO burned. The mean specific heats applicable in the temperature range for the reaction conditions for CO, CO_2, O_2 and N_2 are 29.38,49.91,33.13 and 31.43 (J/mol K) respectively. Calculate the heat evolved in the reaction chamber per kmol of CO burned. **10**

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**

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S.E. / SEM / SEM-III / CBCGS

06/06/19

Evening

Paper / Subject Code: 50706 / Chemical Technology

(3 Hours) (Total Marks : 80)

Please check whether you have got the right question paper.

N.B. : 1) Question no. 1 is compulsory.
2) Solve any three questions from remaining five questions.
3) Draw flow sheets and diagrams wherever necessary.

1. a) Explain isomerization of xylene. (06)
b) Explain membrane cell used in manufacturing of caustic soda. (04)
c) Explain hydrogenation of vegetable oil. What are the products obtained from the hydrogenation of vegetable oil? (06)
d) Explain catalytic convertor used in manufacturing of ammonia with neat sketch. (04)

2. a) Explain with process flow diagram manufacture of phosphoric acid by wet (HCL leaching) process. (10)
b) Explain the following engineering problems related to urea synthesis:- (10)
i) Autoclave variable
ii) Carbamate decomposition and recycle.
iii) Production of granular urea.
iv) Corrosion.

3. a) Explain with process flow diagram manufacture of cumene from benzene and propylene. (10)
b) What is inversion of sugar? Explain manufacturing of sugar with process flow diagram. (10)

4. a) Describe the manufacturing process used for synthesis of BTX. (10)
b) Explain the manufacture of soda ash by Solvay process. How it is different from dual process? (10)

5. a) What are HDPE, LDPE and LLDPE? Explain manufacturing of HDPE. (10)
b) Describe manufacturing process of styrene starting from ethyl benzene. What are the major engineering problems associated with the process? How will you produce 99.9% pure styrene. (10)

6. Write short note on (20)
i) Fluidized catalytic cracking unit
ii) Agrochemical industry in India
iii) Principles used in chemical process industry
iv) Manufacture single super phosphate

SE(IV)(Choice Base)(CH) 7th May 2019 Q.P.Code: 38769

Time: 3 Hours Marks: 80

N.B 1. Q. No.1 is **compulsory.**

2. Answer any **four** out of remaining six questions.

3. Figures to the right indicate full marks.

4. Use of statistical tables is permitted.

5. Write the sub –questions of main question collectively together.

1. a) Using the Newton Raphason method find the root of $x^3 - 5x - 11 = 0$, 5

b) Prove that $f_1(x) = 1$, $f_2(x) = x$, $f_3(x) = (3x^2 - 1)/2$ are orthogonal over (-1,1). 5

c) Determine the nature of the poles & find sum of residues at each pole, $(z) = \frac{z}{az^2+bz+c}$. 5

d) Find the maximum or minimum of the function, 5
$z = x_1^2 + x_2^2 + x_3^2 - 6x_1 - 10x_2 - 14x_3 + 103$.

2. a) Find Fourier series for $f(x) = 2x - x^2$ in (0, 3). 6

b) A tightly stretched string with fixed end points $x = 0$,& $x = L$ in the shape defined by $y = kx(L - x)$ where k is a constant is released from position of rest find y. 6

c) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's $1/3^{rd}$ & $3/8^{th}$ rule. Also find the errors. 8

3. a) Find the Fourier Integral representation of 6
$f(x) = e^{ax}, x \le 0$
$= e^{-ax}, x \ge 0.$

b) Evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+4)(x^2+9)} dx$ using contour integration. 6

c) A rod of length L has its ends A & B kept at 0^0C & 100^0C resp. until steady state conditions prevail. If the temperature at A is raised to 25^0C and that of B is reduced to 75^0C & kept so, find the temperature u(x, t) at a distance x from A & at time t. 8

4. a) Find the missing terms in the following table. 6

x:	1	2	3	4	5	6	7	8
y:	2	4	8	.....	32	.....	128	256.

b) Using Lagrange's multipliers, solve the NLPP. 6

Optimize $z = 12x_1 + 8x_2 + 6x_3 - x_1^2 - x_2^2 - x_3^2 - 23$.

Subject to $x_1 + x_2 + x_3 = 10$,

$x_1, x_2, x_3 \geq 0$

c) Find the Fourier series for $f(x) = \begin{cases} 2, & -2 < x < 0 \\ x, & 0 < x < 2 \end{cases}$ 8

5. a) Find all possible Laurent's series expansions of the function, $f(z) = \frac{1}{z(z+1)(z-2)}$ about $z = 0$ indicating the region of convergence in each case. 6

b) A rectangular metal plate with insulated surfaces is of width a and so long as compared to its breadth that it can be considered infinite in length without introducing an appreciable error if the temperature along one short edge is y=0 given by $u(x,0) = u_0 \sin(\pi x/a)$ for $0 < x < a$ & other long edges $x = 0$ & $x = a$ & the short edges are kept at zero degree temperature, find the function u(x, y) describing the steady state. 6

c) Obtain the complex form of Fourier series for $f(x) = 2x - x^2$ in (0, 2). 8

6. a) Evaluate the integral $\int_C \frac{e^{z^2}}{(z+1)^4} dz$, where C is the $|z - 1| = 3$ using cauchy's integral formala. 6

b) Obtain half range sine series for $f(x) = x(2 - x) in (0, 2)$. 6

c) Using K-T Conditions solve 8

$Maximize\ Z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$,

Subject to $x_1 + x_2 \leq 10$, $x_2 \leq 8$, $x_1, x_2 \geq 0$.

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12/05/18.

Q.P. Code :38916

B.E. Chem (Choice Base) Sem-IV

[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 Attempt **any four** of the following: **20**

a. Calculate transport number of $H^{\oplus}$ ions and Cl^{-} ions from the following data obtained by moving boundary method using cadmium chloride as indicator electrolyte:
- i. concentration of HCl solution =0.25 N
- ii. Mass of silver deposited in the coulometer = 0.15g
- iii. movement of boundary = 8.0cm
- iv. Cross section of tube = $0.58cm^2$
- v. Equivalent weight of silver = 108

b. A cyclic compound with molecular formula C_4H_8 gives one peak in proton NMR spectrum. Predict the structure of the compound with justification. **05**

c. Discuss aromaticity of thiophene **05**

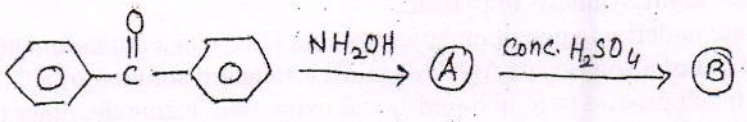
d. Write mechanism and application of Benzil-Benzilic acid rearrangement

e. Write a note on streaming potential. How is it related to zeta potential.

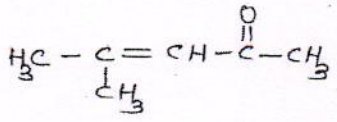
f. Discuss in brief any two applications of Ion-exchange method.

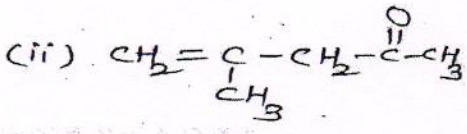
g. Describe a method to titrate strong acid with strong base without using an indicator. Explain the principle involved in it.

Q.2 **a.** Predict **A** and **B** in following reaction and write the name and mechanism of the reaction. **05**



b. What is the principle of UV- visible spectroscopy? Which of the following isomers will absorb at longer wavelengths and why? **05**

(i) 

(ii) 

c. Explain why pyridine is aromatic in nature. **05**

d. Explain any two of the following terms with examples. **05**
- i. Negative catalysis
- ii. Auto catalysis
- iii. Induced catalysis

Q.3	a.	A certain extraction system has a distribution ratio of 10. If 300 mg solute is dissolved in 100ml of solvent A, find out total amount of solute extracted by two extractions with 50 ml of solvent B which is immiscible with solvent A. (The solute has molecular weight 71)	05
	b.	Write the principle and applications of thin layer chromatography.	05
	c.	Derive an expression for the e.m.f. of concentration cell with transference with respect to cations.	05
	d.	Write a short note on Donnan membrane equilibrium and its significance.	05
Q.4	a.	Write preparation of following compounds from acetoacetic ester i. 3,4 dimethylpentan-2-one ii. Isobutyric acid	05
	b.	What is electro-osmosis? How is it demonstrated?	05
	c.	Explain following terms with respect to NMR spectroscopy. i. Chemical shift ii. shielding & deshielding	05
	d.	Give an account of Ion-exchange resins	05
Q.5	a.	Write the characteristics and mechanism of enzyme catalysis.	05
	b.	Explain Huckel's rule of aromaticity with examples.	05
	c.	Explain how e.m.f. measurements can be used to determine the solubility of a sparingly soluble salt.	05
	d.	Write principle and two applications of HPLC	05
Q.6	a.	Give an account of the Debye-Huckel theory of strong electrolytes. Explain what is meant by asymmetry effect?	05
	b.	Write a note on Paal-knorr synthesis of pyrrole.	05
	c.	Discuss the principle underlying potentiometric titration. How can a potentiometric titration be carried out of a solution of $AgNO_3$ against a standard solution of KCl?	05
	d.	Describe in detail batch process used in liquid-liquid extraction. Name the other two methods used for liquid-liquid extraction.	05

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SE (Chemical) (Sem-IV) Chore base

17/5/2019

Time : 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 20

(a) Criteria of Phase Equilibria 05

(b) Equlibrium conversion 05

(c) Excess Properties 05

(d) Tonn of Refrigeration 05

Q 2 (a) The molar enthalpy of a binary mixture is given by 10
$H = x_1(a_1 + b_1x_1) + x_2 (a_2+b_2x_2)$ derive expression for H_1

(b) The activity coefficient data for a binary solution at fixed temperature and pressure are correlated as 10

$\ln\gamma_1 = x_2^2 (0.5 +2x_1)$ $\ln\gamma_2 = x_1^2(1.5- 2x_2)$ Do these equations satisfy Gibbs Duhem equatios.

Q 3 (a) The azeotrope of the ethanol benzene system has a composition of 44.8% (mol) ethanol with a boiling point of 341.4 K at 101.3 kPa. At this temperature the vapour pressure of benzene is 68.9 kPa and the vapour pressure of ethanol is 67.4 kPa . What are the activity coefficients in a solution containing 10% alcohol. 12

(b) Explain in detail criteria of Chemical Reaction equilibrium 08

Q 4 (a) A mixture of 1 mol CO, and 1 mol water vapour is undergoing the water gas shift reaction at a temperature of 1100 K and a pressure of 1 bar. Calculate 12
$CO (g) + H_2O (g) \rightarrow CO_2 (g) + H_2(g)$
The equilibrium constant for the reaction is K=1 . Assume that the gas mixture behaves as ideal gas calculate
i) The fractional dissociation of steam
ii) The fractional dissociation of steam if the reactant stream is diluted with 2 mol nitrogen

(b) What do u understand by the number of degrees of freedom? How is it determined using the phase rule for a non reacting system? 08

Q 5 (a) R-12 is condensed at 30^0C. It is then throttled to -5^0C. Find the refrigerant flow rate that enters the compressor for 1 T of refrigerant. 12

T_{sat}	Psat	H_g KJ/Kg	H_f KJ /Kg
-5^0C	0.2619 MPA	31.42	185.243
30^0C	0.7449 MPA	64.539	199.475

It is assumed that compressor discharged is at the saturated vapour conditions. Find work done by compressor and COP.

(b) A gas mixture containing 2 moles nitrogen , 7 moles hydrogen and 1 mole ammonia initially is undergoing the following reaction 08

$N_2 + 3H_2 \rightarrow 2NH_3$

Derive expression for the mole fraction of various components in the reaction mixture.

Q 6 (a) Vapor liquid equilibrium data for the binary system ethyl acetate (1) and methyl isobutyl ketone (2) is obtained at 760 mmHg pressure and $x_1 = 0.20$ find i) the boiling temperature and y1 ii) If P= 760 and y_1 = 0.8 find t and x1 12

Vanlaar constant A= 0.5713, B= 0.1951 vapor pressure in mmHg

$$log_{10}\ P1^\circ = 7.09808 - \frac{1238.71}{t + 217}$$

$$log_{10}\ P2^\circ = 8.0590 - \frac{2009.5}{t + 273.15}$$

(b) Explain effect of temperature and pressure on chemical Potential 08

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S.E. Chemical – Sem IV Choice Based
23/05/19

[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 from remaining five questions**
3. **Assume suitable data if required.**
4. **Figure to the right indicates full marks.**

Q. 1 A) What are the different particle size analysis techniques? Explain any one. **(05)**
B) Write short note on Floatation. **(05)**
C) Explain the type of packings used in packed bed. **(05)**
D) Explain types of fluidisation. **(05)**

Q. 2 A) A Material is crushed in jaw crusher. Average size of particle reduced from 50mm to 10mm with consumption energy of 13 kW/kg/s. What will be the energy consumption to crush the same material of average size 75mm to average size of 25mm. Assuming: 1) Rittinger's law 2) kicks law 3) bonds law. Which is more reliable result. **(10)**
B) Derive the expression for screen effectiveness. **(10)**

Q. 3 A) Derive the expression for constant pressure filtration. **(10)**
B) A plate and frame press filtering a slurry gave a total of 25 m^3 of filtrate in 30 min and 35 m^3 in 60 min when filtration was stopped. Estimate the washing time in min if 10m^3 of wash water are used the resistance of cloth can be neglected and a constant pressure is used throughout. **(10)**

Q. 4 A) Discuss Kynch theory of Sedimentation. **(10)**
B) List the equipment for continuous filtration. Explain any on in detail. **(10)**

Q. 5 A) Give the classification of size reduction equipments. What are the factor affecting the size reduction? **(10)**
B) Derive the expression to estimate the size of smallest particle that can be separated from cyclone separator **(10)**

Q. 6 A) 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

B) Write short note on **(10)**
i) Muller mixer ii) Screw conveyer

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SE (chem) Sem-IV Choice Base 29/5/19.

[Time: Three Hours] [Marks:80]

N.B. 1 Question **ONE** is compulsory

2 Attempt any **THREE** questions out of the remaining

3 Figure to the right indicate full marks

4 Illustrate answers with sketches wherever required and Diagram at appropriate places carries marks

5 Assume suitable data if necessary and indicate it clearly.

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

(a) Codes and Standards.

(b) Thermal Stresses.

(c) Design Pressure and Design Temperature.

(d) Saddle Supports for Horizontal Vessel.

(e) Metal Joining Technique.

2 (a) Design a pressure vessel for the following specifications: (14)

i) Shell

Internal Diameter = 1200 mm

Material = Stainless steel (SS 304)

Permissible stress for SS at 150^0 C = 130 N/mm^2

Design pressure = 0.6 N/mm^2

ii) Head (Standard Torispherical)

Crown Radius = 1200 mm

Knuckle radius = 6 % of Crown radius

Material = Stainless steel (SS 304)

iii) Flange, Gasket and bolt data:

Gasket factor = 2.0

Minimum design gasket seating stress = 11.2 N/mm^2

Flange material = asbestos

Permissible stress for bolt material = 55 N/mm^2

Design should consist of the following:

i) Shell ii) Head and iii) Flanges with gasket and bolt.

(b) Draw the different formed heads. (06)

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3 (a) A cylindrical storage tank with conical roof and flat bottom has following data: **(14)**

Tank Diameter = 24 m
Tank Height = 16 m
Material of construction = Steel (IS : 2041)
Density of Liquid = 0.001 kg/cm^3
Density of material = 7.7 gm/cc
Superimposed load = 1225 N/m^2
Permissible stress = 140 N/mm^2
Design: 1. Shell plate thickness at various height
2. Conical roof

(b) Draw the different flange faces. **(06)**

4 (a) Write a design procedure for Agitation vessel which includes: (i) Shaft subjected to twisting moment only, (ii) Shaft subjected to bending moment only, and (iii) shaft based on critical speed. **(12)**

(b) Write a design procedure for stuffing box and gland. **(08)**

5 (a) Describe the design procedure for reaction vessel with- **(14)**

1. Plain Jacket
2. Dimple Jacket
3. Half Coil Jacket

(b) Estimate the optimum pipe diameter for a water flowrate of 14 Kg/sec at 20^{0}C. Carbon steel pipe is used. Density of water is 1000 Kg/m^3 and viscosity of water is at 20^{0}C is 1.1 x 10^{-3} Ns/m^2. Also find whether flow is laminar or turbulent. **(06)**

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

(a) Essential accessories of floating roof tank.
(b) Losses in storage of volatile liquids.
(c) Skirt Bearing plate.
(d) Radiographic examination.
(e) Design Procedure of skirt support considering stresses due to wind load.

S.E. Sem IV Choice Base Chemical Engg. Chemical Engineering Economics 04/06/2019

(3 Hours) **Marks : 80**

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

1. Solve any four of the following: **20**

a) Define: i) Depreciation
ii) Service life
iii) Salvage value
iv) Scrap value
v) Book value

b) Explain price discrimination.

c) What is law of demand? Explain with demand curve.

d) Discuss various types of Taxes.

e) Explain Growth v/s Development.

2. a) A glass lined reactor of 150 gal. capacity purchased in 2001 has cost of Rs. 50000. Cost index in 2001 is 237.3. Calculate the cost of the reactor of 450 gal. capacity in 2008 if cost index in 2008 is 248.5. **10**

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

3. a) A reactor which will contain corrosive liquids has been designed. The two alternatives are:

	Reactor A	**Reactor B**
M.O.C.	MS	SS
Installation cost	Rs. 10000	Rs. 25000
Service life	3 Years	-
Scrap value	0	0

On the basis of equal capitalized costs for both types of reactors, what should be the useful-life period for the SS reactor if money is worth 5% compounded annually? **10**

b) Write a short note on Balance sheet. **10**

4. a) A Factory producing 100 electric bulbs a day involves direct material cost of Rs. 250, direct labour cost of Rs. 200 & factory on cost of Rs. 325. Assuming a profit of 12% of the total sales & selling on cost is 30% of the factory cost. Calculate selling price of one electric bulb. **10**

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b) A distillation tower was set up before 10 years at the cost of Rs. 2100000 & life was estimated to be 20 years. Now, at present tower is not working with same efficiency. So company management has taken decision to setup new tower & cost estimated to be Rs. 4500000. The company utilizing its own depreciation fund. Then find out how much amount company will expect by selling initially established tower & what additional amount required to purchase new tower if salvage value of old tower is Rs. 100000 by using Straight Line depreciation method. **10**

5. a) For the case of a nominal annual interest rate of 20% for capital of Rs. 2000, determine:

i) Total amount accumulated after one year (365 days) with daily compounding.

ii) Total amount accumulated after 6 years with continuous compounding.

iii) The effective annual interest rate if compounding is continues. **10**

b) A company has 3 alternative investments, which are being considered. All three investments are for the same type of unit & yields same service only one of the investment can be related. If a company incharge expects 15% rate of return on original investment, which one will be
suitable? **10**

Item	Investment 1	Investment 2	Investment 3
Initial fixed capital (Rs.)	100000	170000	210000
Working capital investment (Rs.)	10000	10000	15000
Annual cashflow (Rs.)	30000	52000	59000
Annual expenditure (Rs.)	15000	28000	21000

6. 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

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TE (IT) (CH) (Choice Based) 9th May 2019

(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.a) Explain False position method using graphical representation. (05)

b) Find LU decomposition of $A=\begin{bmatrix}1 & 2 & 3\\ 4 & 5 & 6\\ 7 & 8 & 9\end{bmatrix}$ (05)

c) How to use Loops in Python? Explain with examples (05)

d) Using Bender-Schmidt method to solve $\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial u}{\partial t} = 0$ given u(0, t)= 0, u(4,t)=0, u(x,0) = x (4-x). Assume h=1.Find the values of u upto t=5 (05)

Q.2.a) Solve the equation $x^3 + x^2 - 1 = 0$ for the positive root by iteration method (Method of successive approximations) (10)

b) Find the positive root of $x = cosx$ using Newton's Method correct to six decimal places. (10)

Q.3. a) Solve the following equations by Gauss-Elimination Method (08)

$$x + 2y + z = 3$$
$$2x + 3y + 3z = 10$$
$$3x - y + 2z = 13$$

b) Solve the following equations by Gauss-Jacobi Method (12)

$$10x - 5y - 2z = 3$$
$$4x - 10y + 3z = -3$$
$$x + 6y + 10z = -3$$

Q.4.a) The change in velocity of a moving particle is given by the following equation (15)

$$\frac{dv}{dt} = 0.025v^2 - 5t$$

Where v is in m/s and t is in seconds. If at t=0, v=5m/s, then find the velocity at t=1.5s taking step size as 0.25. Use Euler's Method.

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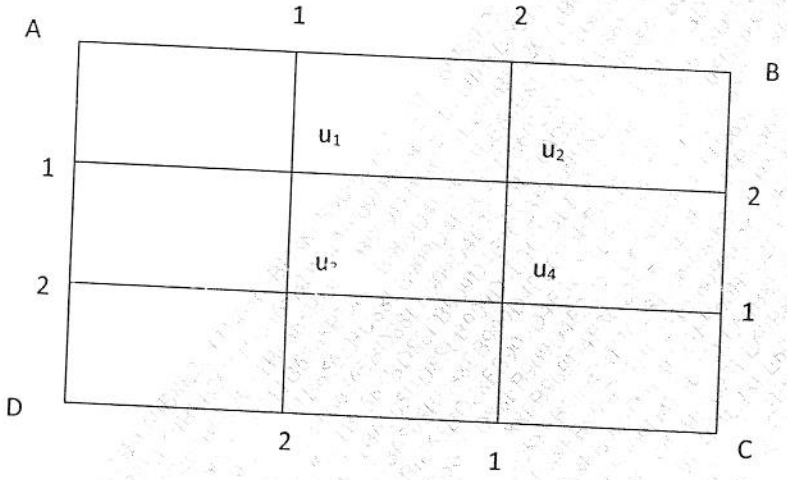
b) Solve by Crank Nicholson method the equation $u_{xx} = u_t$ subject to the condition $u(x,0) = 0\,, u(0,t) = 0\ and\ u(1,t) = t$ taking h=0.25 for one-time steps. (05)

Q.5.a) Solve $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as shown below. (12)



b) Solve $y_{x+2} - 5y_{x+1} + 6y_x = x^2 + x + 1$ (08)

Q.6a) Using Adam-Bashforth predictor-corrector method find y (0.4) (10)
$\frac{dy}{dx} = \frac{1}{2}xy$, y (0) =1, y(0.1)=1.01, y(0.2)=1.022, y(0.3)=1.023

b) Compare Newton Raphson and Secant method of finding roots of nonlinear equations (10)

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15/5/19.

T.E. (CHEM.) CBCGS Sem V.

[3 HOURS]

Total marks 80

NB:

1. Question No1 is compulsory.
2. Attempt any 3 question out of remaining five.
3. Assume suitable data if necessary.

1. a) Methane is cracked on catalyst and Hydrogen is diffused back. In the following reaction find N_A/N_A+N_B 2

$$CH_4=C+2H_2$$

b) What type of towers are suitable for foamy and corrosive liquids 2
Explain loading and flooding in Packed towers in detail 6

c) When a natural draft cooling tower is generally used? 2

d) Calculate the rate of diffusion of water vapour from a thin layer of water at the bottom of the well 6m in depth to dry air flowing over the top of the well. Assume the entire system is at 298^0K and atmospheric pressure. If the well diameter is 3 m, find out the total weight of water diffused per second from the surface of the water in the well. The diffusion coefficient of water vapour in dry air at 298^0K and atmospheric pressure is $0.256X10^{-4}m^2/s$. The partial pressure of water vapour of 298^0K is 0.0323 kg/cm^2 8

2. a) The air pressure in a tyre reduces from 2 bars to 1.99bars in five days. The volume of air in the tube $=0.025m^3$, the surface area $0.5m^2$ and wall thickness 0.01m. The solubility of air in rubber is 0.07m3/m3 rubber. Estimate the diffusivity of air in rubber 10

b) Explain film theory and penetration theory in detail. 10

3. a) Derive the relation between overall mass transfer coefficient and individual mass transfer coefficient when the mass transfer is both gas phase and liquid phase controlled. 10

b) Write short notes on wetted wall column and sparged vessels. 10

4. a) A packed tower is designed to recover 98%CO_2 from a gas mixture containing 10 %CO_2 and 90% air using water. A relation , **10**
y=14 x
can be used for equilibrium conditions where y is(kg of CO_2)/(kg of dry air) and x is (kg of CO_2)/ (kg water)
The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if (HTU)og is 1 meter.

b) Write short notes on **10**
i)Lewis relation ii)Humid volume iii)Adiabatic saturation curves.

5. a) Give classification of cooling towers. Explain each one of them along with diagrams. **8**

b) A batch of solid for which the following table of data applies is to be dried from 25% to 6% moisture under conditions identical to those for which the data were tabulated. The initial weight of the wet solid is 250kg and the drying surface is 1m^2/8kg dry weight. Determine the time for 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

Where , X=kg moisture/kg dry solid
N=kg moisture evaporated/hr m^2

6. Write short notes on **any four** **20**
i) Types of impellers
ii)mass, momentum and heat transfer analogy for laminar flow
iii)Diffusion through polymers
iv)Packed tower vs. tray tower
v)Factors affecting the choice of solvents

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21/05/2019

TE (Chem) / sem-V / ~~CBSGS~~ Choice Based

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

N.B

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

1. Attempt any **four.**

a) An ice box of inner dimensions 1m x 0.7 m x 0.6 m has a 6.5 cm thick layer of thermocol on it as insulation. It contains 12 kg of ice. If the outer surface temperature of the box is 20 ^{0}C, calculate the time required for the ice to melt. Latent heat of ice to water is 3350 KJ/kg ice. The thermal conductivity of the insulation layer is 0.0355 W/m ^{0}C. Assume that this layer virtually offers all the heat transfer resistance. State any other assumption you make. **5**

b) Explain significance of Biot Number and Fourier Number. **5**

c) Explain the regimes of pool boiling. **5**

d) What is fin efficiency and what is fin effectiveness. **5**

e) A person is found dead at 5 pm in a room whose temperature is 20 ^{0}C. The temperature of the body is measured to be 25 ^{0}C when found, and the heat transfer coefficient is estimated to be 8 W/m^2 K. Modelling the body as a 30 cm diameter, 1.7 m long cylinder, estimate the time of death of that person. k = 0.617 W/m ^{0}C, ρ = 996kg/m^3, Cp = 4178J/kg ^{0}C. Solve using lumped parameter system. **5**

2. (a) A steel pipe 25 mm internal diameter and 33 mm outer diameter and insulated with rock wool carries steam at 451 K. If surrounding air temperature is 294 K, calculate the rate of heat loss from one metre length of pipe. The thickness of insulation is 38 mm. Thermal conductivities of steel and rock wool are 44.97 W/(m.K) and 0.175 W/(m.K) respectively. The inside and outside heat transfer coefficients are 5678 W/ (m^2.K) and 11.36 W/ (m^2.K) respectively. Contact resistance between the pipe and insulation may be neglected. **10**

(b) A solid steel ball 50 mm in diameter and initially at a temperature of 723 K is quenched in the controlled environment whose temperature is maintained at a steady value of 363 K. Determine the time taken by the centre of the ball to reach a temperature of 423 K if internal temperature gradient is neglected. **10**

Data: h = 115 W/ (m^2.K), ρ = 8000 kg/m^3, C_p = 0.42 kJ/ (kg.K)

3. (a) Air at 101.325 kPa pressure and 333 K flows parallel to and on both sides of a flat plate (20 cm square) with a velocity of 15 m/s. If the plate is maintained at 293 K, calculate the rate of heat transfer to the plate. Also, calculate and **10**

compare the rate of heat transfer if leading edge is roughened and the boundary layer is entirely turbulent.

Data: The properties of air at the mean film temperature of 313 K are:

$\nu = 16.96 \times 10^{-6}$ m^2/s, $\rho = 1.128$ kg/m^3, $N_{Pr} = 0.699$, $k = 0.0276$ W/(m.K)

(b) A 20 mm φ horizontal heater is maintained at a surface temperature of 313 K and submerged in water at 298 K. Estimate the heat loss/ unit length of heater by natural convection.

Data:- Properties of water at mean temperature of 32.5 ^{0}C are
K = 0.63 w/m K, $\beta = 3.04*10^{-4}$ K^{-1}, $\rho = 1000$ kg/m^3, $\mu = 8*10^{-4}$ kg/m-s, $c_p = 4.187$ kJ/kg ^{0}C.
Use $Nu = 0.53\ (Gr.\ Pr)^{1/4}$ **10**

4. (a) Two long planes A and B are maintained at 600 K and 300 K and their surface emissivities are 0.8 and 0.5 respectively. Two thin radiation shields C and D having emissivities 0.5 and 0.4 are introduced between two planes the given planes. The given planes are in the order A, C, D and B. Assuming all the planes to be infinitely long, find the rate of heat exchange per unit area and steady- state temperatures attained by the planes C and D. **10**

(b) In 1-4 pass STHE, if the tubes are arranged on a 25.4 mm-600 triangular pitch, tube outer diameter is 19 mm. 25% cut segmental baffles are used with 0.15 m baffle spacing. Shell diameter is 10 inch. If shell side mass flow rate is 2083kg/h, estimate shell side Reynold's number ($\mu = 3.3 * 10\text{-}4$ Kg/m-S). **5**

(c) Write short note on Heat Transfer in Agitated Vessels **5**

5. (a) Derive for Counter Flow heat exchanger $\varepsilon = \dfrac{1+e^{-NTU(1-C)}}{1-C.e^{-NTU(1-C)}}$ **10**

(b) Water at 298 K entering a single pass counter flow heat exchanger, at a rate of 0.167 kg/s is to be used to cool oil flowing outside of tubes at a rate double of that of water. Inlet oil temperature is 398 K and sp. heat of oil is 2.1 kJ/kg.K. The tubes specification is 20 mm I.D., 25 mm O.D. and 2.5 m long. Determine the number of tubes required. **10**

Data:
h on oil side = 200 W/(m^2.K)
h on water side = 1500 W/(m^2.K)
C_P of water = 4.2 kJ/(kg.K)
Effectiveness of heat exchanger = 80 %
k for tube material = 46 W/(m.K)

6. (a) Pin fins are provided to increase the heat transfer rate from the hot surface. Two arrangements are available (i) 6 fins of 100 mm length (ii) 10 fins of 60 mm length. By calculation show that, which arrangement is more effective. **10**

Data:
K for fin material = 300 W/m.K
h = 20 W/(m^2.K)
Cross sectional area of fin = 2 cm^2
Perimeter of fin = 5 cm
Temperature of hot surface to which fins are attached = 503 K
The surrounding air temperature = 303 K
Assume that, ends of fins to be insulated.

(b) Write note on various feed arrangements in multiple effect evaporators. 5

(c) Explain Wilson's Plot. 5

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TE CHE SEM-V CHOICE BASED Date: 27/05/2019

(3 Hours) (Total Marks: 80)

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

1 (a) Liquid A decomposes by first order kinetics. In a batch reactor, 50 % of A is converted in 5 minutes. How long it would take to reach 75 % conversion. **05**

(b) The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650 ^{0}C than at 500^{0}C.? **05**

(c) Derive performance equation of a mixed flow reactor for constant density system for first order reaction. **05**

(d) Short note on Recycle Reactor. **05**

2 (a) The rule of thumb that the rate of reaction doubles for a 10 0C in temperature occurs only at a specific temperature for a given activation energy (for specific combination of temperature and activation energy). Show that the relationship between activation energy and temperature for which the rule holds is **10**

$$T = \left[\frac{10\,(K)E}{R \ln 2}\right]^{1/2}$$

(b) Find the first order reaction rate constant k, (referred to A) of the gas reaction 2A→ P, if by keeping the pressure constant, the volume of the reaction mixture, starting with 80 mole% A and 20 mole % inerts, decreases by 20 %in 3 min. **10**

3 (a) It is required to produce 9.5 kg /s of ethylene by cracking a feed stream of pure ethane in a plug flow reactor operated at 1100 K and 6 atm. The cracking reaction is first order with k= 3.07 s^{-1} at 1100 K **10**
$C_2H_6 \rightarrow C_2H_2 + H_2$ find the volume of reactor to achieve 80% conversion of ethane.

(b) The elementary irreversible liquid phase reaction A + B → R + S takes place in a plug flow reactor using equimolar amounts of A and B , $C_{A0} = C_{B0} = 1$ mol/l and results in 96 % conversion of A. If a mixed flow reactor ten times as large as the plug flow reactor were placed in series with the existing reactor, which reactor should come first and by what fraction could the production rate be increased for that set up. **10**

4 (a) Consider the competitive liquid phase reactions : **12**

$A + B \xrightarrow{k_1} R$ (desired) $\frac{dC_R}{dt} = 1.0\, C_A\, C_B{}^{0.3}$ mol/l/min

$A + B \xrightarrow{k_2} S$ (undesired) $\frac{dC_S}{dt} = 1.0\, C_A{}^{0.5} C_B{}^{1.8}$ mol/l.min

Equal volumetric flow rates of the A and b streams are fed to the reactor . each stream has concentration of 20 mol/l. Find the concentration of R in the product stream for $X_A = 0.90$, if the flow pattern in the reactor is

i) Plug flow and ii) mixed flow

(b) Consider a gaseous feed at T_0 = 1000 K, P_0 = 5 atm, CA_0= 100 , CB_0= 200 entering a flow reactor in which the gas phase reaction A+ B → 5R occurs. The Product stream leaves the reactor at T = 400 K, P = 4 atm. For C_A at the reactor exit =20 , find X_A, C_B, and X_B **08**

5 (a) An aqueous solution of ethyl acetate is to be saponified with sodium hydroxide. The initial concentration of ethyl acetate is 5 g/l and that of caustic is 0.1 normal. The values of second order rate constant at 0^0C and 20 ^{0}C are k= 0.235 and 0.924 (l/mol) $(min)^{-1}$ respectively. The reaction is irreversible . Calculate the time required to saponify 95 % of ester at 40^0C **12**

(b) At 500 K the rate of a biomolecular reaction is ten times the rate at 400 K. Find the activation energy for this reaction (a) from Arrhenius law (b) from collision theory (c) what is the percentage difference in rate of reaction at 600 K predicted by these two methods. **08**

6 (a) An irreversible isomerisation reaction is carried out in the liquid phase in a mixed flow reactor **10**

A→R , First order reaction.

Rate constant at 165^0C =0.7 h^{-1}, Activation energy =120000 J/mol, Heat of reaction = -350 kJ/kg

Heat capacity of reactants and products =1.95 kJ/kg.K, Volumetric flow rate = 0.33 m^3/h,

Feed Temperature = 20^0C, conversion expected = 95 %, Calculate the reactor size and temperature of the reaction mixture if the reactor is operated adiabatically.

(b) N_2O_4 gas dissociates according to the following reaction at 27^0C and 1 atm , 20 % of N_2O_4 is dissociated , calculate **10**

$$N_2O_4\,(g) \rightleftharpoons 2\,NO_2\,(g)$$

i) Equilibrium constant K_p

ii) Percent dissociation of N_2O_4 at 27 ^{0}C when total pressure becomes 0.2 atm

iii) What will be the degree of dissociation when we start with 73.6 g of N_2O_4 in 10 litres vessel at 27^0C

T.E. (chem) sem-I choice based 31/05/2019

Time – 3 Hours **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)	Explain classification of Titanium alloys.	5
	b)	Write properties of Nitinol alloy.	5
	c)	Explain cryogenic behavior of stainless steel material.	5
	d)	Write short note on liquid crystal polymer.	5
Q.2	a)	What is High Temperature polymer? Explain several ways by which heat stability of polymer can be increased.	10
	b)	What is closed molding? Explain sheet molding compound process.	10
Q.3	a)	Write short note on carbon composite fabrication method.	10
	b)	Explain laser Ablation method for synthesis of nanotubes	10
Q.4	a)	Explain Sialon processing of ceramics.	10
	b)	Explain hard facing process for thin film coating.	10
Q.5	a)	What is sensitization? Discuss how Inter Granular corrosion is harmful for stainless steel. Suggest the method to minimize it.	10
	b)	Explain Pultrusion method for the manufacturing of composites.	10
Q.6	a)	Explain slip casting process for processing of ceramic along with advantages and disadvantages.	10
	b)	Explain different causes for failure in stainless steel.	10

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TE CVI) (CHEM) (Choice based) 16th May 2019

(3 hours) Marks: 80

NB : 1. Question no. 1 is **compulsory**.
2. Attempt any **three** questions out of remaining **five** questions.
3. Assumptions made should be clearly stated.
4. Figures to the right indicate marks.

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

1. a) Environmental legislation and regulations.
b) Eutrophication in lakes.
c) Isokinetic and non-isokinetic particulate sampling.
d) Classification of hazardous waste based on material properties.
e) Noise pollution causes, consequences and abatement methods.

2. a) Describe sampling and analysis of alkalinity, bacteriological measurements and suspended solids in waste water. **10**

b) Following BOD test was carried out in lab and results are tabulated as follows:- **10**

Time in Day (t)	0	1	2	3	4	5
BOD in mg/lit	0	32	56	85	105	110

Determine the reaction rate constant and ultimate BOD?

3. a) Classify the waste water treatment methods. Discuss one Primary & secondary treatment methods. **10**

b) A completely mixed activated sludge process is to be used to treat waste water flow of 1000 m^3/hr having a soluble BOD_5 of 250 mg/l. Design criteria are as follows: Y = 0.4, Θ_c = 5 days, K_d= 0.1 d^{-1}, k = 8 d^{-1} ; K_s = 75 mg/l; X = 2000 mg/l MLSS Calculate: i) Substrate exit concentration ; ii) Volume of aeration tank iii) The F/M ratio **10**

4. a) Define the terms **10**
   a. troposphere and tropopause
   b. stratosphere and stratopause

Draw a graph showing variation of temperature with altitude in each of the regions and explain why the curve appears as it does in your plot.

b) State various equations for estimation of plume rise for buoyant plumes. **10**

5 a) How are air pollutants classified? List the major types of Air pollutants. Briefly explain the dry deposition mechanism and wet precipitation mechanism of nature for removal of particulate matter. **10**

b) Describe techniques for removal of gaseous pollutants from an effluent stream? **10**

6. a) What are the various methods employed for recovery of material from process effluent? What is its importance? Explain any two methods and its application. **10**

b) Discuss in details Gaussian plume model along with its limitations. **10**

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16/5/2019

TE (Sem VI) | Chemical | Choice based

Duration: -03 Hrs. **Total marks assigned to the paper: - 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. Discuss the requirements of a solvent that can be used in liquid-liquid extraction. [05]

b. The relative volatility for a Benzene-Toluene system is 2.34. Generate the VLE data for this system and plot the same on a x-y plot. [05]

c. Discuss the need for membrane separation operations in chemical engineering and list some of the important operations. [05]

d. Discuss various methods of creating supersaturation during crystallization process. [05]

Q. No. 2

a. A salt solution weighing 15000 kg with 25 % Na_2CO_3 is cooled to 293 K. The salt crystallizes as $Na_2CO_3.10H_2O$. Find the yield of crystals if there is no loss of water by evaporation. The solubility of Na_2CO_3 at 293 K is 21.5 kg of Na_2CO_3 in 100 kg of water. [10]

b. A mixture of 30 mole % of A and 65 mole % of B is to be separated in a distillation column. The concentration of A in the distillate should be 96 $mole$ % and 97 % of all A is in the distillate. The feed is half vapor and the reflux ratio is 3.5: 1. How many equilibrium stages are required? The relative volatility is 2.51 [10]

Q. No. 3

a. If 150 kg of solution (A+C) containing 28 % C is to be extracted 3 times using 40 $kg\ of\ pure\ B$ in each stage, in a three stage cross current operation. Determine

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quantities and compositions of various streams. The equilibrium data in wt % is given below. R indicates raffinate phase and E indicates extract phase

R	C	0.69	1.41	2.89	6.42	13.30	25.50	26.70	44.30	46.40
	A	98.1	97.1	95.1	91.7	84.4	71.1	58.9	45.1	37.1
	B	1.2	1.5	1.6	1.9	2.3	3.4	4.4	10.6	16.5
E	C	0.18	0.37	0.79	1.93	4.82	14.40	21.60	31.10	36.20
	A	0.5	0.7	0.8	1.0	1.9	3.9	6.9	10.8	15.1
	B	99.3	98.9	98.4	97.1	93.3	84.7	71.5	58.1	48.7

[10]

b. One liter flask is containing air and acetone at 1 atm and 303 K with a relative humidity of 30 % of acetone. 2.5 g of fresh activated carbon is introduced into the flask and the flask is sealed. Compute the final vapor composition and final pressure neglecting adsorption of air. The equilibrium data is given below

$g\ adsorbed/g\ carbon$	0	0.1	0.2	0.3	0.35
Partial pressure of acetone [mm of Hg]	0	2	12	42	92

[10]

Q. No. 4

a. Oil is to be extracted from meal by means of benzene, using a continuous counter current extractor. The unit is to treat 1200 kg of meal (based on completely exhausted solids) per hour. The untreated meal contains 360 kg of oil and 35 kg of benzene. The exhausted solids are to contain 60 kg of unextracted oil. The fresh solvent stream contains 16 kg oil and 595 kg benzene.

Experiments carried out under conditions identical with those of the projected battery, show that the solution retained depends upon the concentration of the solution as follows

$kg\ oil/kg\ solution$	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
$kg\ solution/kg\ solid$	0.5	0.505	0.515	0.530	0.550	0.571	0.595	0.620

[10]

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b. Discuss any two ion exchange equipments. [10]

Q. No. 5

a. Derive Fenske's equation for calculating minimum number of stages in a distillation column. [08]

b. Discuss break through curve in unsteady state adsorption. [08]

c. Explain why the VLE curve lies above the diagonal line when vapor phase composition is plotted on Y-axis and liquid phase composition is plotted on X-axis. [04]

Q. No. 6

Write short notes on the following. [Any four]

a. Ultra-filtration.

b. Minimum boiling azeotropes.

c. $\Delta L's$ law of crystal growth

d. Binodal solubility curve

e. Reverse Osmosis.

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TE – Chemical – Sem VI 22/05/2019 Choice Based

(3 hour) Max Marks: 80

NB:

1. Question No. 1 is compulsory
2. From the remaining five questions answer any three.
3. All parts of a question and subquestion should be attempted in one place.
4. Figures to the right indicate full marks

1. a. Describe the analogies between momentum, heat and mass transfer [5]
   b. Explain the shear stress versus shear strain curve for Newtonian and non-Newtonian fluid. [5]
   c. Explain the temperature dependency of thermal conductivity of liquid and gas. [5]
   d. Differentiate between molar flux J_A and N_A. [5]

2. a. Derive equation of continuity. [12]
   b. The space between two parallel plates is 0.5 cm. It is filled with oil of viscosity $\mu = 0.4\times10^{-2}$ Pa.s. at 303 K. The lower plate is pulled at a relative velocity of 0.366 m/sec greater than the top plate. Calculate the shear stress and shear rate. [8]

3. a. Derive the velocity profile for flow through a circular tube and find the average velocity and maximum velocity for flow through a circular tube [14]

   b. A small capillary tube with an inside diameter of 2.2×10^{-3} m and length of 0.317 m is being continuously used to measure the flow rate of liquid having density of 990 kg/m^3 and $\mu=1.13\times10^{-3}$Pa.sec. The velocity of liquid is 0.275m/sec. Calculate pressure drop in the tube. [6]

4. a. Show that the temperature rise is a parabolic function of the distance r from the wire axis for heat conduction with an electrical heat source. [12]

   b. A furnace wall is exposed to hot gases at 1100K. The wall consists of 0.12m of fire brick and 0.25 m of common brick. Heat transfer coefficients on the hot side are 3000 W/m^{2}K and 22 W/m^{2}K on the outside. Ambient air is at 300K. What is the heat transfer rate per square meter of wall? k=0.138W/mK for both brick. [8]

5. a. Write the dimensionless numbers correlating mass transport, heat transport and momentum transport processes. [8]

b. In a O_2 –N_2 gas mixture at 1 atm and 25°C, the concentration of O_2 at two planes, 2 mm apart, are 10 and 20 % (v/v) respectively. Calculate the flux of diffusion of O_2 for the case where

i. N_2 is non-diffusing.

ii. There is equimolar counter diffusion of gases. Data: $D_{O2-N2} = 1.86 \times 10^{-5}$ m^2/sec at 0°C and $D_{O2-N2} = 2.064 \times 10^{-5}$ m^2/sec at 25°C [12]

6. Write short notes on **any four**: [20]

a. Role of Peclet no. in mass transfer and heat transfer processes

b. Hagen-Poiseuille equation.

c. Diffusion of gas A through non diffusing gas B

d. Non-Newtonian fluids

e. Commonly used boundary conditions in laminar flow momentum transport problems.

T.E (chem) sem - VI choice based 28/05/2019.

(3 Hours) [Total Marks : 80]

N.B. (i) Question number 1 is compulsory.
(ii) Answer any three questions from rest.
(iii) Assume suitable data wherever necessary.

Q. 1. A) Explain Pulse input experiment for RTD measurement [5]

B) In an experiment to determine the pore volume and catalyst particle porosity the following data were obtained on a sample of activated silica
Mass of catalyst sample placed in chamber = 101.5 gm
Volume of helium displayed by the sample = 45.1 cm^3
Volume of mercury displayed by sample = 82.7 cm^3
Calculate the required properties [5]

C) Explain the following terms [5]

(i) Hatta number (ii) Effectiveness factor

D) What is tracer and what are the properties of tracer? [5]

Q. 2. A) The concentration readings given below represent a continuous response to pulse input into a closed vessel. [15]

Time t (sec)	10	20	30	40	50	60	70	80
Tracer conc., gm/lit	0	3	5	5	4	2	1	0

i) Tabulate and plot E & F curve
ii) Calculate mean residence time
iii) Variance of response to pulse input
Determine the fraction of material leaving the reactor that has spent between 20 & 60 sec in the reactor.

B) Explain dispersion model [5]

Q. 3. A) Calculate the time required for complete burning of particles of graphite (*size: Ro = 5 mm, density:* $\rho_B = 2.2$ *gm/cc*) in an *8%* oxygen stream at *900°C and 1 atm.*
For the high gas velocity used assume that film diffusion does not offer any resistance to transfer and reaction. Data: *Rate constant* = $k'' = 20$ *cm/sec* [10]

B) An ore of uniform size particles is to be roasted in a fluidized bed reactor. The time required for complete conversion of solid particles is 20 min and the mean residence time of particles in the bed is 48 min. the solids remain unchanged in size during reaction. Calculate the fraction of the original ore remaining unconverted assuming (i) the chemical reaction step to be rate controlling (ii) the ash diffusion step to be rate controlling [10]

Q. 4. A) Ethanol can be produced by catalytic vapour phase hydration of hydration of ethylene at 135 atm and 573 K.

$C_2H4 + H_2O \longleftrightarrow C_2H_5OH$

$A + B \longleftrightarrow R$

The rate expression for this reaction is

$(-r_A) = zk_Ak_B(p_Ap_B-p_R/K) / (1 + k_Ap_A + k_Bp_B)^2$, mol/(gm.cat.h)

Where $z = 0.018$, $k_A = k_B = 0.003$

The equilibrium constant is given by

$RT\ lnK = 30T - 9730$ where $R = 1.987$ cal/(mol.K)

The total feed rate to PFR is 10 kg/h with equimolar amounts of ethylene and steam. Find the weight of catalyst needed to achieve 20% conversion of ethylene. [12]

B) 10 m3/h of a gaseous feed containing A & B passes through an experimental reactor packed with 4 kg of catalyst.

The stoichiometry and rate are given by

$A + B \longrightarrow R + S$

$(-r_A) = 0.6\ C_A\ C_B$, mol/kg.h

Find the conversion of reactants if the feed to the reactor contains 0.1 mol A/m^3 and 10 mol B/m^3 [8]

Q. 5. A) Develop Langmuir Hinshelwood model for the following reaction when adsorption of A is rate limiting step [12]

$A + B \longleftrightarrow R + S$

B) Explain BET method for determination of surface area of solid catalyst [8]

Q. 6. A) Explain contacting patterns (schemes) for two phase systems [5]

B) Explain helium mercury method to determine void volume & solid density [5]

C) Derive an expression of time required for complete conversion of spherical particle when diffusion through gas film control the overall reaction rate. [10]

T.E. Sem-VI Chemical Engg. Choice Based 03/05/2019

[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** 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 Explain any one of the relief system with diagram. 5

Determine the TLV for a uniform mixture of dusts containing the following particles 5

Type of Dust	Concentration (wt %)	TLV(mppcf)
Dust A	70	20
Dust B	30	2.7

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

Performance of boilers is checked by which parameters?-Explain. 5

Q.2 a Write on disaster of Bhopal Gas plant from the perspective of Technical Failures and Consequences. 10

b If the UFL for a substance is 11.0 % by volume at 0 MP gauge, what is the UFL at 6.2 gauge? 4

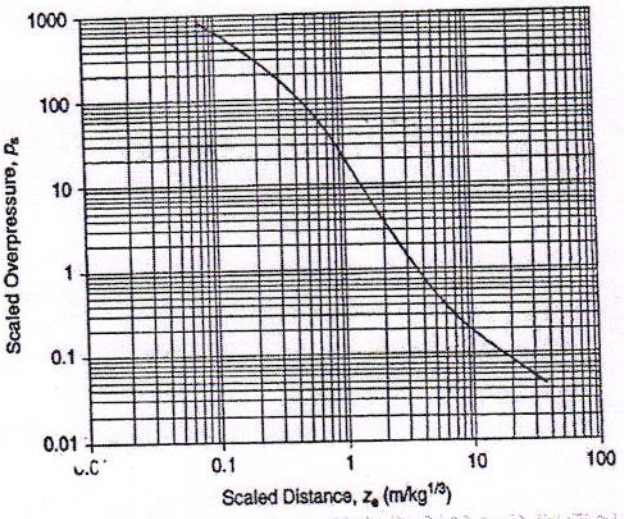
c Define: - (i) Detonation (ii) Deflagration (iii) Confined explosion (iv) Unconfined explosion. 6

Q.3 a What are the main tasks of Industrial hygienist? Explain Anticipation and identification in detail with examples. 10

b 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

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

b 10



One Thousand kilogram of methane escapes from a storage vessel, mixes with air, and explodes. Determine (a) The equivalent amount of TNT and (b) the side on peak overpressure at a distance 50 m from the blast. Assume an explosion efficiency of 2 %. ΔH_c for Methane is 802.3 kJ/mol and the energy of explosion of TNT is 4686 kJ/kg.

Q.5 a A certain quantity of steam in a closed vessel of fixed volume of 0.14 m^3 exerts a pressure of 10 bar at 250 C. If the vessel is cooled so that the pressure falls to 3.6 bar, determine: (a) the final quality of steam, (b) the final temperature, (c) the change in internal energy, and (d) the heat transferred during the process. Take Cp for superheated steam as 2.1 kJ/kg K. 10

b Explain one of the mounting and one of the accessories used with boilers using diagrams. 10

Q.6 a Derive equation for work done per kg of air delivered for single acting reciprocating compressor with clearance volume. 10

b A single stage double acting reciprocating air compressor delivers 14 m^3/ min air at 1.01325 bar and 288 K. The pressure and temperature of air during suction are 0.95 bar and 305 K. The delivery pressure is 0.7 MPa. Assuming compression and expansion follow the law $PV^{1.3} = C$, taking clearance 5% of stroke, determine 10

1. I. P. required to run the compressor
2. Volumetric Efficiency

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T.E(Chem)/Sem VI/CBCGS — 10/06/2019

Paper / Subject Code: 88868 , Elective - II Biotechnology (T.S)

(3 Hours) **Total marks: 80**

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

Q1. Write short notes on **any four**. **20**

a) Modern biotechnology

b) RNA structure and its function.

c) Bioinformatics

d) Surface Immobilization

e) Cell fusion technology

Q2. a) Give the classification of microorganism. Differentiate between prokaryotes and eukaryotes in terms of their internal structure and functions. **10**

b) i) Give the difference between micronutrients and macronutrients **5**

ii) Why biotechnology is an interdisciplinary pursuit? **5**

Q3 a) With suitable diagram explain stages in production of liquid enzyme preparation. **10**

b) What is enzyme immobilization? Describe briefly the various methods of enzyme immobilization. **10**

Q4 a) Explain the Industrial Application of Enzymes **10**

b) What is the impact of pharmaceuticals and biopharmaceuticals product on human life? **10**

Q5 Explain **any two** from the following:- **20**

i. Dialysis and Reverse osmosis
ii. Chromatography
iii. Crystallization and drying

Q6 Explain application of Biotechnology in the following **20**

i. Food and Beverages
ii. Agriculture

B. E. (VII) (CBSGS) (CHEM) 7th May 2019

(3 Hours) (Total Marks : 80)

N. B. : 1) Question No. 1 is compulsory.
2) Solve any three questions from question Nos. 2 to 6.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever necessary but justify the same.

1. Explain **any four :** **20**

a) Difference between U-tube and Fixed tube heat exchangers.
b) Shrink fit construction of high-pressure vessel.
c) Elastic stability for tall column.
d) Design of buried pipeline.
e) Explain Spray Dryer.

2. (a) Design a fixed tube sheet heat exchanger having the following data : **20**

Shell design pressure	= 0.6 N/mm^2
Permissible stress for shell material	= 95 N/mm^2
Tube design pressure	= 2 N/mm^2
Tube outside diameter	= 20 mm
Tube Pitch	= Tringular
Tube length	= 2500 mm
Number of tubes	= 40
Number of passes on tube side	= 2
Shell flange	Raised facing Gasket used is flat metal jacketed asbestos filled Design seating stress = 53.4 N/mm^2 Gasket factor = 3.75 Allowable stress for bolt material = 138N/mm^2
Channel flange	Permissible stress for flange material = 100N/mm^2 Joint with tubesheet = Ring facing Gasket factor =5.5 Design seating stress for gasket =126.6 N/mm^2

Design should include (i) shell (ii) Tubesheet (iii) Shell flange (iv) Channel flange (v) Channel and Channel cover

3. (a) Write a detail design procedure with relevant equations for standard vertical calendria type evaporator. **14**

(b) Explain standard vertical short tube evaporator with neat sketch. **06**

4. (a) A closed vessel is to be designed to withstand an internal design pressure of 150N/mm^2. An internal diameter of 300mm. Following properties may be assumed Yield strength = 700 N/mm^2 , Ultimate Tensile strength = 500 N/mm^2, Poisson' s ratio = 0.3, Estimate the wall thickness by using factor of safety 1.5 based on yield strength on the basis of : **10**
   i) Maximum Principal Stress theory.
   ii) Maximum Shear stress Theory.
   iii) Maximum Principal strain Theory.
   iv) Distortion energy theory.

   (b) Explain material of construction for high pressure vessel. **05**

   (c) Estimate the optimum diameter of a pipe for allowing the flow of a liquid at the rate of 10.5 kg per second, when the temperature is 26^{0}C and the other data is as below : **05**
   Density of the liquid = 1105 kg/m^3.
   Viscosity of the liquid = 1.15 x 10^{-3} Nsec/m^2.
   Material of pipe = carbon steel.
   Also determine whether the flow of the liquid is laminar or turbulent.

5. (a) Explain design procedure for determination of shell thickness at different heights for distillation column. **15**

   (b) Describe different types of packing used in packed column. **05**

6. (a) Explain piping and instrumentation diagram and draw P &ID for single reactor. **10**

   (b) Explain in detail Rotary disc filters with its parts. **10**

Paper / Subject Code: 41902 / Process Engineering

Date:-13/05/19.

B.E. CHEM C CBSGS) VII Semester

(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) Write and explain general material balance over: 04
(i) Mixer (ii) Splitter

(b) What are the applications of "vacuum" and "nitrogen" as utility in chemical industries? 04

(c) Based upon degree of freedom analysis, how the number of controllers required in any process are decided? What are the general thumb rules to be followed while designing control structure for process? 04

(d) What are the design heuristics for selecting between Batch and Continuous process? 04

(e) Explain the concept of "fire triangle" and different types of fire 04

Q.2. (a) What are the common features of sulphonation process? Draw PPS for manufacture of linear alkyl benzene sulphonate from linear alkyl benzene and SO_3 as raw materials. Also explain why hot dry air is mixed with SO_3 vapours used for sulphonation. (10)

(b) What can be various types of feed impurities and according to characteristic of each type of impurity, what feed purification guidelines, will you suggest? (10)

Q.3. (a) A feed mixture containing 70 moles of component 1, 100 moles of component 2 and 90 moles of component 3 is to be separated in flash column. Pressure and temperature for this flash operation is 1400 mm Hg and 300 K respectively. The overhead recovery of key component is 60%. Then calculate the component flow rates in overhead and bottom stream from flash column. The component with intermediate volatility can be selected as key component. (10)

Data:

Component	Antoine Constants		
	A	B	C
1	15.84	2480	- 40
2	15.82	2200	- 36
3	15.68	2150	- 34

TURN OVER

(b) Consider the reactor where the following reactions are occurring. Methane and Ethane are the limiting reactants in the 1st and 2nd reaction respectively. Conversion per pass is 70% and 80% for the 1st and 2nd reaction respectively. Then develop the general model of material balance equations for each of the components involved in this process. **(10)**

$$CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O$$

$$C_2H_6 + 3.5\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O$$

Q.4. (a) 900 gmol/s of 60/40 mole% mixture of benzene and xylene are separated at 2 atm in distillation column. The overhead recoveries of light and heavy key components are 0.8 and 0.15 respectively. Then find the theoretical number of trays, reflux ratio and column height if 24" tray spacing and disengagement space of 2 m each at top and bottom is used (ignore support height). **(10)**

Data:

Component	P_{vap} (kPa)	T_{boil} (K)
Benzene	91.5	353.3
Xylene	11.17	417.6

(b) A counter current heat exchanger is used to cool the air from 386 K to 305 K with cooling water entering at 300 K and leaving at 322 K. The overall heat transfer coefficient for this heat exchanger is 120 W/m^{2}K. Heat duty for this HEx is 30 kW. Then calculate updated bare module cost for this HEx. **(10)**

$\mathbf{S_o}$ = 5.5 ft^2, α = 0.024, $\mathbf{C_o}$ = Rs. 20400, **MF** = 1.83, $\mathbf{F_m}$ = 1.78, $\mathbf{F_p}$ = 0.25, $\mathbf{F_d}$ = 0.85, **CI** in base year = 395, **CI** in present year = 1125.

Q.5. (a) Discuss in detail, the role of Process engineer in process industries. **(10)**

(b) Explain in detail about "Fault Tree Analysis", risk assessment methodology. **(10)**

Q.6. (a) For the process stream data given below, determine $\mathbf{Q_{H,min}}$, $\mathbf{Q_{C,min}}$ and pinch temperature for $\Delta\mathbf{T_{min}}$ = 10 °C. **(10)**

Streams	MCp (kW/°C)	Tin (°C)	Tout (°C)
1	6	60	180
2	5.2	30	130
3	4	180	40
4	8	150	40

(b) Discuss about PFD in detail. **(10)**

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BE (Chemical) / Sem-VII / [3 Hours] / CBSGS 17/12/2019

[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. Discuss the needs of controlling a chemical process. [05]

b. Derive and plot response of a first order system to a step input of magnitude M. [05]

c. The following reaction takes place in a CSTR at a constant temperature

$$3A \xrightarrow{k_1} B \qquad -r_A = k_1 C_A^3$$

where C_A is the concentration of A in the reactor. Derive the transfer function relating the outlet concentration C_A to the inlet concentration C_{Ai}. Assume volume is constant [05]

d. Discuss in brief control valve characteristics. [05]

Q. No, 2

a. Derive the dynamic model for stirred tank heating process with variable hold-up. [10]

b. With usual notation derive closed loop transfer function for servo and regulator problem. [10]

Q. No. 3

a. A stirred-tank reactor has an internal cooling coil to remove heat liberated in the reaction. A proportional controller is used to regulate coolant flow rate so as to keep the reactor temperature reasonably constant. The controller has been designed so that the controlled reactor exhibits typical under damped second-order temperature response characteristics when it is disturbed, either by feed flow rate or by coolant temperature changes.

   i. The feed flow rate to the reactor changes suddenly from 0.4 to 0.8 kg/s, and the temperature of the reactor contents, initially at 100 °C, changes eventually to 104^{0}C. What is the gain of the transfer function (under feedback control) that relates changes in reactor temperature to changes in feed flow rate? (Be sure to specify the units.).

ii. The operator notes that the resulting response is slightly oscillatory with maxima estimated to be 104.5^{0}C and 104 ^{0}C occurring at times 1000 and 3060 s after the change is initiated. What is the complete process transfer function?

iii. The operator failed to note the rise time. Predict t_r based on the results in (i) and (ii). [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}=600 kg/min, w_{2s}=300 kg/min, x_{1s}=0.4, and x_{2s}=0.75. Suddenly the inlet flow rate w_2 decreases to 115kg/min and remains there. Determine an expression for the mass fraction of the solute $x(t)$. Assume that liquid hold up is constant. [10]

Q. No. 4

a. Consider a feedback control system in which $G_C(s) = K_C$, $G_V(s) = \frac{1}{3s+1}$, $G_P(s) = G_d(s) = \frac{1}{5s+1}$ and $G_m(s) = 1$. Determine the range of K_C for which the system is closed loop stable. [10]

b. Discuss frequency response of a first order system. [10]

Q. No. 5

a. Write short notes on the following

i. Gain and Phase margin

ii. Nyquist Stability criterion [10]

b. For a unit feedback system $G(s) = \frac{K}{s(s+4)(s+2)}$ Sketch the root locus showing all details on it. Comment on the stability of the system. [10]

Q. No. 6

a. Discuss feedback control of a first order system using a proportional controller. You may ignore the dynamics of other elements in the closed loop. [10]

b. Write short notes no the following

i. Cohen Coon tuning method

ii. Ziegler Nichols tuning method. [10]

BE CHEM/SEM-VII CBSGS/ 23/05/2019.

[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 out of remaining five questions.
3. Figures to the right indicate full marks.
4. Neat flow sheets must be drown whenever necessary.

Q.1 Explain and discuss the importance of the following **20**
- **a)** Viscosity index
- **b)** Reid Vapor Pressure
- **c)** Flash point and fire point
- **d)** ASTM and TBP distillation

Q.2
- **a)** What is the importance of evaluation of crude oil and name the list of different products with their boiling range, obtained from an oil refinery? **10**
- **b)** Distinguish between pump around and pump back reflux in atmospheric distillation unit. **10**

Q.3
- **a)** Explain in detail the process of visbreaking with neat flow diagram. **10**
- **b)** Explain the process of fluid catalytic creaking (FCC) with neat flow diagram. **10**

Q.4
- **a)** Explain HF alkylation process and give comparison between HF alkylation and sulfuric acid alkylation process. **10**
- **b)** Discuss in brief the process of furfural extraction process for lubricating oil. What are the advantages of using furfural over phenol as a solvent? **10**

Q.5 **a)** What are the different applications of Asphalt? Explain air blowing process for Bitumen manufacturing with neat flow diagram. **10**
- **b)** Why isomerization is carried out in refinery? Explain the process of Isomerization in detail. **10**

Q.6 Write short notes on following **20**
- **a)** Liquid Paraffin
- **b)** Classification of Refineries
- **c)** Composition of crude oil
- **d)** Selecto forming process

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BE (VIII) (CHEM) (CBSGS) 8th May 2019

(3 Hours) Marks 80

N.B. 1 Question number ONE is compulsory
2 Attempt any THREE questions out of remaining FIVE
3 Figure to right indicate full marks

01.		Write short note on (any four)	20
	(a)	Letter of Intent (LOI)	
	(b)	Economic Order Quantity	
	(c)	Project Overrun	
	(d)	Concept of Entrepreneur	
	(e)	GANTT chart	
02.	(a)	Explain the project phases with the help project life cycle curve	10
	(b)	Discuss the various types of work breakdown structure (WBS) in detail.	10
03.	(a)	Explain start-up and stabilization projects	10
	(b)	Describe in brief classification and types of entrepreneurship.	10
04.	(a)	Prepare feasibility report for any chemical industry	10
	(b)	Differentiate between CPM and PERT	10
05.	(a)	Explain the meaning and usefulness of intellectual property rights	10
	(b)	Explain tools and technique used for achieving project quality control	10
06.	(a)	Explain different inventory techniques. Explain in brief ABC & VED analysis	10
	(b)	Explain in brief various types of cost estimates	10

B.E (Chem) CBSGS Sem VIII

Date 14/05/19.

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.

1. (a) Briefly discuss the Hydrologic Cycle. 04
(b) Explain the effects of the following: 06
(i) Ozone layer depletion
(ii) Oxides of sulfur
(c) Define the terms: MLSS and DO. Explain their significance in wastewater treatment. 06
(d) Explain the methods of collection of solid waste. 04

2. (a) Describe the use of adsorption system for recovery of solvent vapors from an air streams. Explain the selection of adsorbents & regeneration methods used. 10
(b) The town of Venkatapur discharges 17,360 m^3/d of sewage into a nearby stream. The stream has a minimum flow of 0.4 m^3/s, depth of 2.5 m and a velocity of 5 kmph. Other information pertaining to the stream and the sewage are as follows: 10

	Temp (^0C)	DO (mg/l)	BOD_5 (mg/l)
Stream	20	8.5	10
Sewage	25	1.0	200

The deoxygenation constant (k_1) evaluated at $20^0C = 0.35\ d^{-1}$. Determine the critical oxygen deficit, D_c, and its location, X_c.

3. (a) Describe the various methods available for the removal of nitrogen & phosphorus from waste water. 10
(b) A plate-type electrostatic precipitator for use in a cement plant for removing dust particles consists of 10 equal channels. The spacing between the plates is 0.15 m, and the plates are 2 m high and 2 m long. The unit handles 10,000 m^3/hr of gas. What is the efficiency of collection? What should be the length of the plates for achieving 99% collection efficiency if other condition are the same? 10

4. (a) Explain BOD test used for analysis of water pollutant in waste water. Explain the method to obtain ultimate BOD of the sample. 10

(b) The behavior of particulate pollution in the atmosphere is influenced by their relative sizes. Explain how the size of a particulate makes a difference? 10

5. (a) Describe any one method for the design of a thickener for the case of zone settling. 10

(b) Describe the operation of a typical facultative pond. Discuss the basic reactions taking place in a facultative pond and the transfer of materials between the various zones of the pond. 10

6. Write short notes on any four:- 20

(i) Eutrophication in lakes
(ii) Dispersion model
(iii)Electrostatic precipitator
(iv)Hazardous Waste Management
(v) Noise Pollution Control

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Paper / Subject Code: 52504 / 2) Advanced Seperation Technology

BE (Chemical) / Sem-VIII / CBSGS

20/5/2019

Time: 3 Hours Marks: 80

1. **Question 1 is compulsory.**
2. **Answer any Three questions from the remaining questions.**
3. **Right figures indicate full marks.**
4. **Assume suitable data if required.**

Q 1: Answer any four of the following: [20]

a. Write short note on dialysis.
b. Discuss adsorption properties of foam
c. Explain retention time, retention volume and resolution in liquid chromatography
d. Write note on membrane fouling
e. Discuss adsorption breakthrough curve in detail

Q. 2:

a. Discuss Pressure swing adsorption process using any example with a neat diagram . [10]
b. What are the different equipments used for continuous adsorption . Discuss any one of them in detail. [10]

Q. 3:

a. Explain the principle of foam fractionation with any its application in mineral processing. [10]
b. Discuss the phenomenon of foam formation, coalescence, collapse and drainage in details. [10]

Q. 4:

a. Explain the principle of HPLC and with the help of schematic diagram discuss various components of HPLC. [10]
b. Discuss any one application of liquid chromatography. [5]
c. Explain the working of reverse phase column chromatography. [5]

Q. 5:

a. What do you mean by membrane modules. Explain hollow fibre module in details. [10]
b. Derive the relation for flux in a dialysis process. i.e. [10]

$$NA = \frac{C_1 - C_2}{\frac{1}{kC_1} + \frac{1}{kC_2} + \frac{1}{P_m}}$$

Q. 6: Write short note on: [20]

a. Reverse osmosis
b. Plate and frame module
c. Affinity chromatography
d. Modern adsorbents

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71051

B. E (Chem). Sem - VIII 24/05/2

(3 Hours) (CBSGS) (Total Marks : 80)

N.B. 1) Question No.1 is compulsory

2) Answer any three out of five question

3) Assume suitable data wherever necessary and state them clearly

4) Figure to the right indicate full marks

Que. 1

a) Write short note on liquid activity coefficient model. [05]

b) For a binary system consider a simplest excess function, the suffix margules model, $\frac{G^E}{RT} = Ax_1x_2$, What are the activity coefficients for this model? [05]

c) Write mass balance equations for the following with neat sketch. [05]

1. Mixer
2. Splitter
3. Heat exchanger

d) Draw the neat sketch of Distillation column and Write the ξ_{ik} values for following component type in distillation Model. [05]

1. Heavier than heavy key
2. Heavy Key
3. Lighter than Light Key
4. Light key
5. Lighter than Light Key
6. Distributed component

Que. 2

a) Explain model non ideal flash column with neat sketch [10]

b) 97 % 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 9 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 A and B are mixed with recycle stream enter CSTR, where following reactions take place [20]

$$A + B \rightarrow C$$
$$C + B \rightarrow P + R$$
$$P + C \rightarrow G$$

Here, C is an intermediate, P is main product, R is bi product and G is oily waste. The plant consist of reactor, a heat exchanger to cool reactor effluent, a decanter to separate waste product G from reactants and other products and a distillation

column to separate product P. 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

$\Delta G_{f\,CO_2} = -94.26\ kcal/gmol$ $\Delta G_{f\,CO} = -32.81\ kcal/gmol$

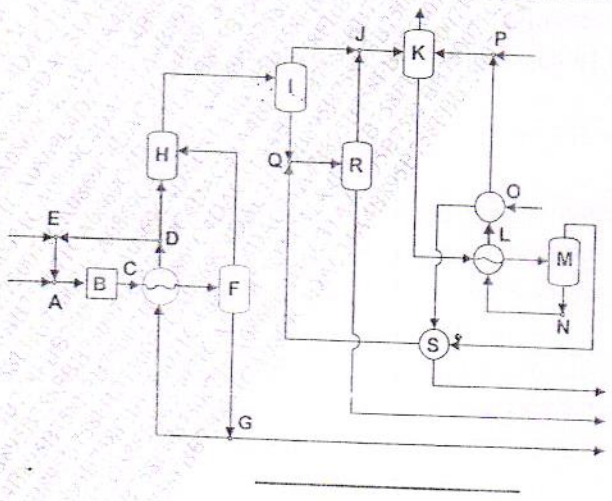
$\Delta G_{f\,H_2O} = -54.64\ kcal/gmol$ $\Delta G_{f\,H_2} = 0\ kcal/gmol$

b) Solve the following problem by Lagrange multiplier. [10]

Maximize $f(x,y) = x^2y$

Subject to, $x^2 + y^2 = 1$

Que. 6 For the flow diagram given below find the partitions and develop precedence order [20]



Paper / Subject Code: 52510 / Energy System Design

BE (chem) Sem- VIII @ CBSGS 30/5/2019

Q.P.CODE: 26760 morning

(Time:3 hour) [Total marks: 80]

N.B.:

1) **Question-1 is compulsory. Answer any three questions from 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 i.e. one below the other**

1 a) Why steam economy is more in case of multiple effect evaporator as compared to single effect evaporator **(5)**

b) What energy steps should be followed when motors are running during periods when the equipment or process they are driving is idle **(5)**

c) Discuss renewable and non-renewable sources of energy with examples **(5)**

d) Discuss co-generation and its advantages **(5)**

2 a) Explain various energy efficient steps to improve energy efficiency of a steam generation system **(12)**

b) Discuss different steps of "detailed energy audit" **(8)**

3 a) Estimate minimum utility requirement of hot and cold and pinch temperature for the process stream given below: **(10)**

ΔT_{min}=15°C

Stream	T^s(°C)	T^t(°C)	mCp (KW/°C)
1	180	80	2
2	130	40	4
3	60	100	8
4	30	120	3.6

b) For the system explained in Q. No. 3 (a), design a Heat Exchanger Network (HEN), both above and below the pinch to meet the minimum utility requirement, without any violation of ΔT_{min} approach. **(10)**

4 a) A forward feed triple effect evaporator is used to concentrate dilute solution. The steam (at 121°C and 4093 kh/hr) is used as heating source in 1st effect, however in 2nd and 3rd effect vapors generated in previous effect are used as heating source. The latent heat (λ) of steam used to 1st effect is 2200 kJ/kg. Other useful data is as given below: **(20)**

	Effect 1	Effect 2	Effect 3
U (W/m^2K)	3100	2000	1100
ΔT (°C) (adjusted for cold feed condition)	18	17	34
Vapor generated (kg/hr)	2480	2660	2858
λ (kJ/kg)	2249	2293	2377

Calculate :

i. Boiling point temperatures in each effect
ii. Heat transfer area in each effect
iii. Steam economy

5 a) A stream of 15,500 lb of saturated steam at 250psig is being expanded through a pressure reducing valve, to obtain process stream at 50psig. Determine the potential for electricity generation if the stream is expanded using single stage back pressure 3600 RPM turbine generator (8)

Data given:
Steam rate: 15,500 lb/hr
Inlet steam enthalpy (hi) : 1201.7 Btu/lb
Outlet steam enthalpy (ho): 1090.8 Btu/lb
Turbine speed: 3600 RPM
Corresponding values of theoretical stream rate (TSR) and Actual Steam Rate (ASR) for 3600 RPM are as below:

TSR(lb/KW-hr)	17.5	25	30.7	35.5
ASR(lb/hp-hr)	22.5	32.5	38.5	45

b) Discuss "combined cycle cogeneration "with suitable example (8)
c) In case of cogeneration plant what is the definition of the terms "Process Returns (PR)" and "Net Heat to Process (NHP)". (4)

6 Write short notes on:
a) Energy auditors tool box (5)
b) Direct and indirect benefits of waste heat recovery (5)
c) Generalized rule for stream splitting on hot side of pinch to satisfy MER requirement (5)
d) Heat pumping in distillation (5)

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