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Total No. of Pages : 3

Seat No.	

S.E. (Chemical Engineering) (Semester - III) (Revised) Examination, December - 2015

ENGINEERING MATHEMATICS - III

Sub. Code : 63421

Day and Date : Monday, 7-12-2015 **Total Marks : 100**

Time : 10.00 a.m. to 01.00 p.m.

Instructions :
1) **Attempt any three questions from each section.**
2) **Figures to right indicate full marks.**
3) **Use of non-programmable calculator is allowed.**

SECTION - I

Q1) a) Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 6e^{3x} + 7e^{-2x}$. **[6]**

b) Solve $\frac{d^2y}{dx^2} - 4y = x\sinh x.$ **[6]**

c) Solve $(D^2 + 4)y = \cos 2x.$ **[5]**

Q2) a) A tank initially contains 50 gallons of fresh water. Brine, containing 2 pounds per gallon of salt, flows into the tank at the rate of 2 gallons per minute and the mixture kept uniform by stirring, runs out at the same rate. How long will it take for the quantity of salt in the tank to increase from 40 to 80 pounds? **[8]**

b) A long hallow pipe has an inner diameter of 10 cm and outer diameter of 20 cm. The inner surface is kept at 200°C and the outer surface at 50°C. The thermal conductivity is 0.12. How much heat is lost per minute from a portion of the pipe 20 meters long? Find the temperature at a distance $x = 7.5$ cm from the centre of pipe. **[8]**

Q3) a) Round off the number 37.46235 to four significant figure and compute relative error and percentage error. **[5]**

P.T.O.

b) Using Newton Raphson method find the root of $2x^3 - 3x + 4 = 0$ lying between –2 and 1 correct to four decimal places. [6]

c) Find the root of $f(x) = x^3 + x^2 + x + 7$ by Secant method correct to three decimal places. [6]

Q4) a) Solve $\frac{d^4y}{dx^4} + 13\frac{d^2y}{dx^2} + 36y = 0$. [4]

b) Solve the simultaneous linear equations $\frac{dx}{dt} + 5x - 2y = t, \frac{dy}{dt} + 2x + y = 0$. [7]

c) Find a root of the equation $x^3 - 4x - 9 = 0$, using the bisection method correct to four decimal places upto the 5th stage. [5]

SECTION - II

Q5) a) Find Laplace transform of $\int_0^t \frac{e^t \sin t}{t}\, dt$. [5]

b) *If* $L[f(t)] = \frac{1}{S}\, e^{-1/s}$, find $L[e^{-t} f(3t)]$. [5]

c) Evaluate using Laplace transform $\int_0^\infty t\, e^{-3t} \sin t\, dt$. [6]

Q6) a) Find inverse Laplace transform of $\frac{s^2 + 3s + 3}{(s^2 + 2s + 2)(s^2 + 2s + 5)}$. [6]

b) Find inverse Laplace transform using convolution theorem $\frac{s^2}{(s^2 + 4)^2}$. [6]

c) Show that $L^{-1}\left[\frac{1}{s}\cos\left(\frac{1}{s}\right)\right] = 1 - \frac{t^2}{(2!)^2} + \frac{t^4}{(4!)^2} - \frac{t^6}{(6!)^2}$. [5]

Q7) a) Fit a straight line to the following data

Year x	1951	1961	1971	1981	1991
Production (000 tons) :	10	12	8	10	13

Also estimate the production in 1987. **[8]**

b) Find the equation of the lines of regression from the following data

x :	62	64	65	69	70	71	72	74
y :	126	125	139	145	165	152	180	208

[8]

[8]

Q8) a) Solve using Laplace transform

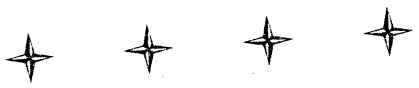
$(D^2 + 4D + 8)\, y = 1$, with $y = 0$, $Dy = 1$ at $t = 0$.

b) The equation of the two lines of regression are $6y = 5x + 90$ and $15x = 8y + 130$

Find i) Mean of x and y.

ii) The coefficient of correlation

iii) If variance of x is 16, find σy (standard deviation of y). **[9]**



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Seat No.	

Total No. of Pages : 3

S.E. (Chemical Engineering) (Semester - III)
Examination, November - 2016
ENGINEERING MATHEMATICS - III
Sub. Code : 63421

Day and Date : Tuesday, 15 - 11 - 2016 **Total Marks : 100**

Time : 10.30 a.m. to 01.30 p.m.

Instructions : 1) **Attempt any three questions from each section.**
2) **Use of non programmable calculator is allowed.**
3) **Figures to the right indicate full marks.**

SECTION - I

Q1) a) Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = x^2 + e^x + \cos 2x$ **[6]**

b) Solve $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = e^{2x}\sin x$ **[6]**

c) Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x\sin x$ **[5]**

Q2) a) A tank contains 5000 liters of fresh water. Salt water which contains 100 gm of salt per liter flows into it at the rate of 10 liters per minute and the mixture kept uniform by stirring, runs out at the same rate. When will the tank contain 200000 gm of salt?

How long will it take for the quantity of salt in the tank of increase from 150000 gm to 250000 gm? **[8]**

b) A pipe 10 cm in diameter contains steam at 100°C. It is covered with asbestos 5 cm thick, for which k = 0.0006 and the outside surface is at 30°C. Find the amount of heat lost per hour from a meter long pipe.**[8]**

P.T.O.

Q3) a) Round off the number 865250 to four significant figures and compute absolute and relative error. **[4]**

b) Using Secant method, find the fourth root of 32 correct to three decimal places. **[6]**

c) Find by Newton-Raphson method, the real root of the equation

$e^x = x^3 + cos25x$ which is near 4.5 **[6]**

Q4) a) Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x\log x$ **[5]**

b) Solve the simultaneous equations : $\frac{dx}{dt} + 2y = e^t, \frac{dy}{dt} - 2x = e^{-t}$. **[6]**

c) Find a positive real root of $xlog_{10}x = 1.2$ using the bisection method. **[6]**

SECTION - II

Q5) a) Find the Laplace transform of $t^2e^{-t}\ sin4t$ **[5]**

b) Find $L\left[\int_0^t ue^{-3u}\ sin4u\ du\right]$ **[6]**

c) Find $L\left[\frac{1-cost}{t}\right]$ **[5]**

Q6) a) Find inverse Laplace transform of $\frac{2s+3}{(s+1)^2(s+2)}$ **[6]**

b) Find $L^{-1}\left[\cot^{-1}\left(\frac{2}{s}\right)\right]$ **[5]**

c) Using Convolution theorem obtain inverse Laplace transform of

$$\frac{S}{(S^2+4)^2}$$ **[6]**

Q7) a) Obtain the lines of regression from the following data. Also find the best estimate of y when x = 13 and the best estimate of x when y = 8

x :	2	4	6	8	12	14
y :	4	2	5	10	11	12

[9]

b) A simply supported beam carries a concentrated load P at its mid point. Corresponding to various values of P the maximum deflection y is measured as follows **[8]**

P :	100	120	140	160	180	200
y :	0.45	0.55	0.6	0.7	0.8	0.85

Find the law of the form y = c + mP

Q8) a) Using Laplace transform solve the differential equation **[8]**

$$\frac{d^2y}{dx^2}+2\frac{dy}{dx}-3y=0 \text{ at } x=0,\ y=0 \text{ and } \frac{dy}{dx}=4$$

b) Fit a second degree parabola to the following data **[8]**

x :	10	20	30	40	50	60	70
y :	20	60	70	80	90	100	100

Also estimate y when x = 80

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Seat No.	

S.E. (Chemical Engineering) (Semester – IV) Examination, 2008
ENGINEERING MATHEMATICS – IV

Day and Date : Monday, 10-11-2008 Total Marks : 100
Time : 2.30 p.m. to 5.30 p.m.

Instructions : *1) Attempt **any three** questions from **each** Section.*
*2) Figures to the **right** indicate **full** marks.*
*3) Use of non-programmable calculator is **allowed**.*

SECTION – I

1. Solve : **16**

   i) $p - q = x^2 + y^2$

   ii) $x\frac{\partial z}{\partial y} = y\frac{\partial z}{\partial x} + x\, e^{x^2+y^2}$.

   iii) $(y - x)(qy - px) = (p - q)^2$.

   iv) $p(1 + q^2) = q(z - a)$.

2. Solve : **16**

   i) $p(1 + q) = q^z$.

   ii) $px(z - 2y^2) = (z - qy)(z - y^2 - 2x^3)$.

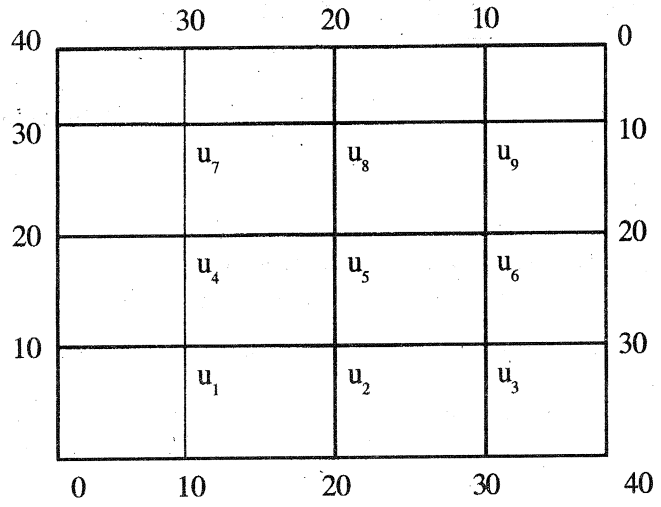
   iii) $\frac{\partial z}{\partial x} - 2\frac{\partial z}{\partial y} - (y + 1)\, e^{3x} = 0$.

   iv) $4xyz = pq + 2px^2y + 2qxy^2$.

3. a) Solve $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ by method of separation of variables. **7**

P.T.O.

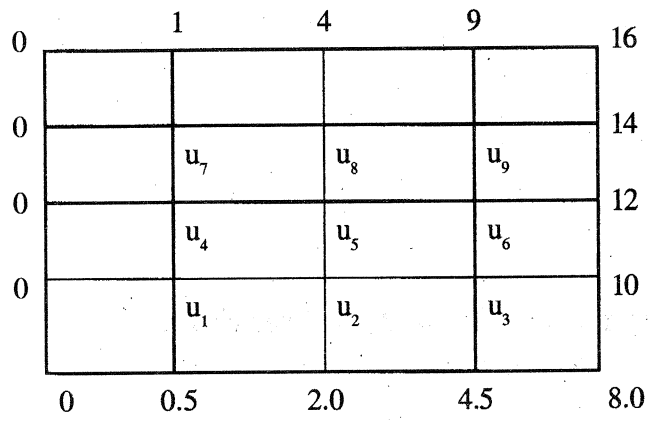
b) Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the following data by successive iterations : **10**



4. A tightly stretched string with fixed end points x = 0 and x = L is initially at rest in its equilibrium position. If it is set vibrating by giving to each of its point a velocity $\left[\frac{\partial y}{\partial t}\right]_{t=0} = 3(Lx - x^2)$, find y(x, t). The differential equation satisfied by y is

$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$. **16**

5. Solve Laplace's equation for the figure given below : **17**



SECTION – II

6. a) For $0 \le x \le 2\pi$ and $k \neq 0$, prove that

$$\pi e^{kx} = \left(e^{2k\pi} - 1\right)\left[\frac{1}{2k} + \sum_{n=1}^{\infty} \frac{k\cos nx - n\sin nx}{k^2 + n^2}\right]. \quad \textbf{10}$$

b) Obtain the half-range cosine series for $f(x) = kx$ for $0 \le x \le 1/2$

$= k(1-x)$ for $1/2 \le x \le 1$. **6**

7. a) Find a series of cosines of multiples of x which will represent x sin x in the interval $[0, \pi]$ and show that

$$1 + \frac{2}{1.3} - \frac{2}{3.5} + \frac{2}{5.7} - - - .\infty = \frac{\pi}{2}. \quad \textbf{8}$$

b) Obtain the fourier series for the function f(x) given by

$$f(x) = 1 + \frac{2x}{\pi}, -\pi \le x \le 0$$

$$= 1 - \frac{2x}{\pi}, 0 \le x \le \pi$$

and hence deduce that

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\infty = \pi^2/8. \quad \textbf{9}$$

8. a) Fit a curve $y = ax^b$ to the following : **8**

x:	1	2	3	4	5
y:	0.5	2	4.5	8	12.5

b) Fit a binomial distribution to the following : **9**

x:	0	1	2	3	4	5
y:	2	14	20	34	22	8

9. a) Calculate the lines of regression and coefficient of correlation from the following : **8**

x:	65	66	67	67	68	69	70	72
y:	67	68	65	68	72	72	69	71

b) Fit a straight line to the following : **8**

x:	0	1	2	3	4
y:	1	1.8	3.3	4.5	6.3

10. a) Out of 320 families 5 children each, find the expected number of families having 0 boys, 1 boy and 2 boys assuming boys and girls are equally likely. **8**

b) An aptitude test for selecting officers in a Bank is conducted on 1000 candidates. The average score is 42 and standard deviation of score is 24. Assuming normal distributions for the scores, find (i) the number of candidates whose score exceed 60 (ii) the number of candidates whose score lie between 30 and 60.

[generated by an Adobe applicationGiven Area from $z = 0$ to $z = 0.5$ is 0.1915
$z = 0$ to $z = 0.75$ is 0.2734]

8

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Seat No.	

S.E. (Chemical Engg.) (Semester – IV) Examination, 2011
ENGINEERING MATHEMATICS – IV

Day and Date : Thursday, 19-5-2011 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

***Instructions** : 1) Attempt **any three** questions from **each** Section.*

*2) Figures to the **right** indicate **full** marks.*

*3) Use of calculator is **allowed**.*

SECTION – I

1. a) Fit a parabola $y = a + bx + cx^2$ to the following data : **8**

x =	0	1	2	3	5	6
y =	3	12	31	60	148	207

b) From a certain data of seven observations the following were obtained. $\Sigma x = 408$, $\Sigma y = 279$, $\Sigma x^2 = 23812$, $\Sigma y^2 = 11193$, $\Sigma xy = 16306$. But while checking it was found that (58, 39) and (62, 44) were wrongly read as (57, 37) and (61, 43). Find the correct correlation coefficient and lines of regression. **8**

2. a) Two lines of regression of y on x and x on y are available for some data as $0.1757x - 0.1234y = 5.3174$ and $0.2345x - 0.143y = 7.9752$ respectively. Find their means and correlation coefficient between them. **5**

b) Fit a straight line $y = a + bx$ to the following data : **6**

x =	0	1	2	3	4	5	7
y =	5	11	17	23	29	35	47

c) A random variable x has the following probability distribution : **6**

x =	1	2	3	4	5	6	7
P(x) =	k	2k	3k	k^2	k^2+k	$2k^2$	$4k^2$

Find i) k ii) $P(2 < x \leq 5)$ iii) mean of x

P.T.O.

3. a) In a lot of 500 solenoids 25 are defective. How many packets would you expect to have i) no defective ii) atleast one defective solenoid in a consignment of 10000 packets if each packet contains 20 solenoids. **5**

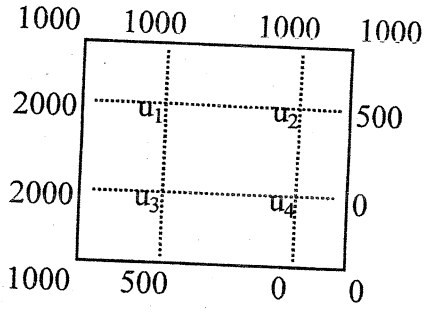
b) The number of accidents on a particular highway is a Poisson variate with parameter 5. Find the number of days in a month on which i) atmost two accidents ii) atleast two accidents have occurred. **5**

c) If x is a normal variate with mean 50 and variance 100. Find the probability that x satisfies $|x - 60| > 15$. **6**

Given : Area under S.N. curve between z = 0 to 0.5 is 0.1915 and

Area under S.N.curve between z = 0 to 2.5 is 0.4938

4. Obtain the difference equation for $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ and solve it for the following mesh points (upto five iterations) using Gauss-Seidal method. **17**



SECTION – II

5. Solve :

a) $(1 - y^2)xq^2 + y^2p = 0$. **5**

b) $z^2 (p^2 + q^2 + 1) = 1$. **5**

c) $p \tan x + q \tan y = \tan z$. **6**

6. a) Solve :

$(x + y)(p + q)^2 + (x - y)(p - q)^2 = 1.$ **7**

b) If $f(x) = \left(\frac{\pi - x}{2}\right)^2$ in the range $[0, 2\pi]$, show that in this range

$f(x) = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{\cos nx}{n^2}$ and hence deduce the following relations :

i) $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots\infty = \pi^2/6$.

ii) $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\infty = \pi^2/12$

iii) $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\infty = \pi^2/8$. **10**

7. A tightly stretched string with fixed end points x = 0 and x = L is initially at rest in its equillibrium position. If it is set vibrating giving to each of its point a velocity $\left.\frac{\partial y}{\partial t}\right|_{t=0} = 3(Lx - x^2)$

Find y(x, t). The differential equation satisfied by y is $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$. **16**

8. a) If $f(x) = \pi x, \quad [0 \le x \le 1]$
$= \pi(2 - x), \quad [1 \le x \le 2]$
Show that in the range [0, 2] **9**

$f(x) = \pi/2 - 4/\pi \sum_{n=0}^{\infty} \frac{\cos(2n+1)\pi x}{(2n+1)^2}$.

b) Expand $f(x) = e^x$ as a cosine series over [0, 1]. **8**

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Total No. of Pages : 4

Seat No.	

S.E. (Chemical) (Part -II) (Semester - IV) Examination, May - 2015
ENGINEERING MATHEMATICS - IV
Sub. Code : 43656

Day and Date : Tuesday, 05 - 05 - 2015 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) **Attempt any three questions from each section.**
2) **Figures to the right indicate full marks.**
3) **Use of non programmable calculator is allowed.**

SECTION - I

Q1) a) Fit a parabola $y = a + bx + cx^2$ to the following data. **[8]**

x :	2	4	6	8	10
y :	3.07	12.85	31.47	57.38	91.29

b) The following table gives the test scores (X) and productivity indices (Y) of 10 workers selected at random **[8]**

X:	60	62	65	70	72	48	53	73	65	82
Y:	68	60	62	80	85	40	52	62	60	81

Find two regression equations. Estimate the productivity index of a worker whose test score is 92.

Q2) a) The following data relate to the prices and supplies of commodity during a period of eight years: **[5]**

Price (Rs./kg):	10	12	18	16	15	19	18	17
Supply (100kg):	30	35	45	44	42	48	47	46

Calculate the coefficient of correlation between the two series.

P.T.O.

b) Fit a straight line $y = a + bx$ to the following data. **[6]**

x:	0	1	2	3	4	5	7
y:	5	11	17	23	29	35	47

c) A random variable X has the following probability distribution. **[6]**

x:	0	1	2	3	4	5	6	7	8
P(x):	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

i) Find a

ii) Find $P(X<3), P(2\leq X<5)$

iii) Mean of X.

Q3) a) Six dice are thrown 729 times. How many times do you expect at least three dice to show a 5 or 6? **[5]**

b) If the chance of being killed by flood during a year is $\frac{1}{300}$, using Poisson distribution find the probability that out of 3000 persons living in the area at least one would die in flood in that year. **[5]**

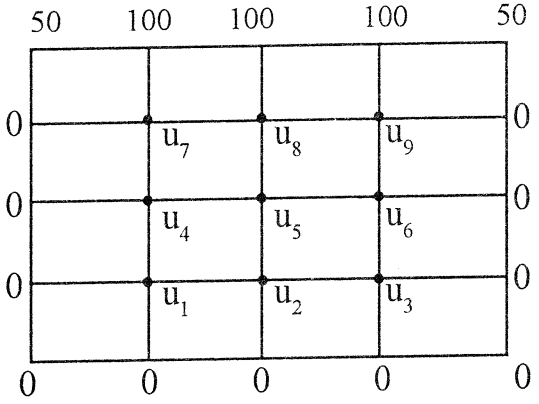
c) The weights of 4000 students are found to be normally distributed with mean 50 kilograms and standard deviation 5 kilograms. Find the number of students with weights **[6]**

i) less than 45 kilograms

ii) between 45 and 60 kilograms

[for S.N.V.Z, area between $z = 0$ and $z = 1$ is 0.3413 and between $z = 0$ and $z = 2$ is 0.4772].

Q4) Solve Laplace equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ for the following mesh points upto four iterations using Gauss-Seidal method. **[17]**



SECTION - II

Q5) Solve:

a) $z\left(p^2+q^2\right)=x^2+y^2$. **[6]**

b) $p^2+q^2=z$. **[5]**

c) $\left(z^2-2yz-y^2\right)\frac{\partial z}{\partial x}+\left(xy+zx\right)\frac{\partial z}{\partial y}-xy+zx=0$. **[6]**

Q6) A rectangular plate with insulated surfaces is 10cm wide and so long compared to its width that it may be considered infinite in length without introducing an appreciable error. If the temperature of short edge y = 0 is given by

$V=20x \quad$ for $0\le x\le 5$

$=20(10-x) \quad$ for $5\le x\le 10$

and two long edges $x=0, x=10$ as well as other short edges are kept at 0°C, find the temperature at any point (x, y) if the differential equation satisfied by temperature V at steady state is $\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}=0$. **[17]**

Q7) a) Find a Fourier series for $f(x)=x-x^2$ in $[-1,1]$ and hence show that

$$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+.....\infty=\frac{\pi^2}{12}.$$ **[10]**

b) Obtain a sine series for e^x in the interval $0\le x\le 1$. **[6]**

Q8) a) Solve: $y^2p^2-xq^2=xy^2z$. **[8]**

b) Prove that in the interval $0\le x\le\pi$ **[8]**

$$x(\pi-x)=\frac{\pi^2}{6}-\left\{\frac{\cos 2x}{1^2}+\frac{\cos 4x}{2^2}+\frac{\cos 6x}{3^2}+.....\right\}.$$

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SM - 20

Seat No.	

Total No. of Pages : 4

S.E. (Chemical Engg.) (Part - II) (Semester - IV) Examination, April - 2016
ENGINEERING MATHEMATICS - IV
Sub. Code : 63427

Day and Date : Sunday, 17 - 04 - 2016 **Total Marks : 100**

Time : 10.30 a.m. to 01.30 p.m.

Instructions : 1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Use of calculator is allowed.**

Q1) Attempt any three from the following : **[18]**

a) A particle moves along the curve $x = t^3 + 2t$, $y = -3e^{-2t}$, $z = 2 \sin 5t$. Find the velocity and acceleration and thier magnitudes at $t = 0$.

b) If $\phi = x^2 + y^2 + z^2$, $\psi = x^2y^2 + y^2z^2 + z^2x^2$, find $\nabla[\nabla\phi.\nabla\psi]$

c) Find the directional derivative of $\phi = x^2 y \cos z \, at \, (1, 2, \pi/2)$ in the direction of $\bar{a} = 2i + 3j + 2k$

d) If $\phi = x^3 + y^3 + z^3 - 3xyz$ then find

i) div $(\bar{F})$

ii) curl $(\bar{F})$ where $\bar{F} = \nabla\phi$

Q2) Attempt any two of the following : **[16]**

a) Find the Fourier transform of $f(x) = \begin{cases} 1 - x^2 & if \; |x| \leq 1 \\ 0 & if \; |x| > 1 \end{cases}$

and hence evaluate $\int_0^\infty \frac{x \cos x - \sin x}{x^3} \cos\left(\frac{x}{2}\right) dx$

b) Find the Fourier Sine and Cosine transform of $f(x) = 2e^{-5x} + 5e^{-2x}$

P.T.O.

c) Find the Finite Fourier Sine and Cosine transform of $f(x)=\frac{\pi}{3}-x+\frac{x^2}{2\pi}$ in $(0,\pi)$

Q3) Attempt any two of the following : **[16]**

a) From the following table calculate the angular velocity and angular acceleration at t=1

t=	0	0.2	0.4	0.6	0.8	1.0	1.2
θ=	0	0.12	0.48	1.1	2	3.2	4.72

b) Find the first and second derivative at x = 0.04 from the following :

x =	0.01	0.02	0.03	0.04	0.05	0.06	0.07
y =	0.1023	0.1047	0.1071	0.1096	0.1122	0.1148	0.1172

c) Find $f'(5)$ and $f''(5)$ from

x	=	0	2	3	4	7	9
f(x)	=	4	26	58	112	466	922

Q4) Attempt any three from the following : **[18]**

a) Verify whether the following functions are probability density functions or not.

i) $f(x)=\frac{2}{9}x\left(2-\frac{x}{2}\right)$ for $0\le x\le 3$

ii) $f(x)=\frac{1}{2}c^{-|x|}$ for $-\infty<x<\infty$

b) From a box containing 100 transistors 20 of which are defective, 10 are selected at random. Find the probability that

i) all are defective

ii) all are good

iii) at least one is defective

c) If the probability that an aidividual suffers a bad reaction from a certain injection is 0.001. Determine the probability that out of 2000 individuals

i) exactly 3

ii) more than 2 will suffer a bad reaction

d) Weights of 4000 students are found to be normally distributed with mean 50 kg and standard deviation 5kg. Find the number of students with weights

i) less than 45 kg

ii) between 45 and 60 kg

(For S.N.V.z, area between $z = 0$ and $z = 1$ is 0.3413 and between $z = 0$ and $z = 2$ is 0.4772)

Q5) Attempt any two of the following : **[16]**

a) Find the Fourier series for $f(x) = x^2$ in $-1<x<1$ and hence deduce that

$$\frac{\pi^2}{12} = 1 - \frac{1}{4} + \frac{1}{9} - \frac{1}{16} + - - -$$

b) Obtain the Fourier series for e^{-x} over $-\pi \leq x \leq \pi$

c) Find the half range sine series for $f(x) = \begin{cases} x & 0 < x < \pi/2 \\ \pi - x & \pi/2 < x < \pi \end{cases}$

Q6) Attempt any one of the following : **[16]**

a) Solve the equation $\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}$ for the conduction of heat along a rod without radiation subject to the following conditions

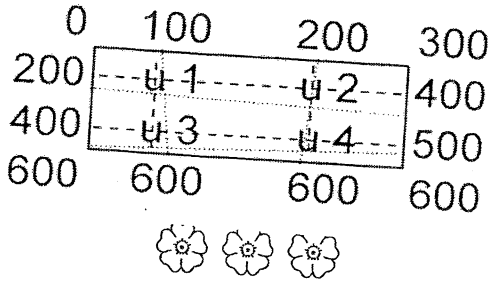
i) u is finite when $t \to \infty$

ii) $\frac{\partial u}{\partial x} = 0$ when $x = 0$ for all t

iii) $u = 0$ when $x = l$ for all t

iv) $u = u_0$ when $t = 0$ for $0 < x < l$

b) Solve the Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ by using Gauss - Seidal method upto fourth iteration for the following sqaure mesh with boundary values as shown



(Question Paper 2017 - S.E/T.E./B.E May/April)

SL-598

Seat No.	

Total No. of Pages :4

S.E.(Chemical Engg.) (Semester - IV) (Revised)
Examination, April - 2017
ENGINEERING MATHEMATICS -IV
Sub. Code: 63427

Day and Date : Tuesday, 25 - 04 - 2017 **Total Marks : 100**
Time :10.00 a.m. to 1.00 p.m.

Instructions :
1) **All questions are compulsory.**
2) **Figure to the right indicates full marks.**
3) **Use of non-programmable calculator is allowed.**
4) **Assume suitable data if necessary.**

SECTION-I

Q1) Attempt any three of the following:

a) Find constant a and b such that the surfaces $ax^2 - byz = (a+2)x$ will be orthogonal to the surface $4x^2y + z^3 = 4$ at the point $(1, -1, 2)$. **[6]**

b) Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ in the direction from this point towards the point $(4, -4, 8)$. **[6]**

c) If $\vec{a}$ is constant and $\vec{r} = xi + yj + zk$ then prove that $\nabla \cdot \left(\frac{\vec{a} \times \vec{r}}{r} \right) = 0$. **[6]**

d) If $\phi(x, y, z)$ and $\vec{V}(x, y, z)$ are any scalar and vector point functions respectively, then show that gradϕ is irrotational and curl $\vec{V}$ is solenoidal vector. **[6]**

P.T.O.

Q2) Attempt any two of the following:

a) Find the Fourier transform of **[8]**

i) $e^{-x^2/2}$

ii) $f(x)=\begin{cases} e^{i\omega x}, & a<x<b \\ 0, & \text{otherwise} \end{cases}$

b) Find the finite cosine transform of **[8]**

i) $f(x)=\frac{\pi}{3}-x+\frac{x^2}{2\pi}$

ii) $f(x)=\sin nx$

c) Find f (x) if its Fourier sine transform $\frac{s}{1+s^2}$. **[8]**

Q3) Attempt any two of the following:

a) Find the first and second order derivative at $x = 1.6$ from the table given below: **[8]**

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y	7.989	8.403	8.781	9.129	9.451	9.750	10.031

b) Find the first, second and third derivatives of the function tabulated below, at the point $x = 1.5$. **[8]**

x	1.5	2.0	2.5	3.0	3.5	4.0
y	3.375	7.0	13.625	24.0	38.875	59.0

c) Find $f'(0)$ from the following data: **[8]**

x	3	5	11	27	34
$f(x)$	-13	23	899	17315	35606

SECTION-II

Q4) Attempt any three of the following:

a) The probability density function of random variable X is **[6]**

x	0	1	2	3	4	5	6
P(x)	k	3k	5k	7k	9k	11k	13k

Find

i) $p(x < 4)$

ii) $p(3 < x \leq 6)$

b) Out of 1000 families with 4 children each how many would you expect to have: **[6]**

i) 2 boys, 2 girls

ii) at least one boy

c) The probability of failure in physics practical examination is 20%. If 25 batches of 6 students each take the examination in how many batches 4 or more students would pass. **[6]**

d) In a sample of 1000 student the mean and standard deviation of marks obtained by the students in a certain test are 14 and 2.5. Assuming the distribution to be normal find the number of students getting marks. **[6]**

i) between 12 and 15

ii) above 18

(Given: For a S.N.V. z area between z = 0 and z = 0.4 is 0.1554, that between z = 0 and z = 0.8 is 0.2881, that between z = 0 and z = 1.6 is 0.4452)

Q5) Attempt any Two of the following:

a) Obtain the Fourier expansion of $f(x)=\left(\frac{\pi-x}{2}\right)^2$ in the interval

$0 \leq x \leq 2\pi$ and $f(x+\pi)=f(x)$.

Also deduce that $\frac{\pi^2}{6}=\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\ldots$ **[8]**

b) Obtain Fourier series for [8]

$$f(x) = x + \frac{\pi}{2}, -\pi < x < 0$$
$$= \frac{\pi}{2} - x, 0 < x < \pi$$

Hence, deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots$

c) Find half range sine series for $x \sin x$ in $(0, \pi)$. [8]

Q6) Attempt any Two of the following:

a) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x,0) = y_0 \sin^3\left(\frac{\pi x}{l}\right)$. If it is released from rest this position, find the displacement y at any distance x from one end and at any time t. [8]

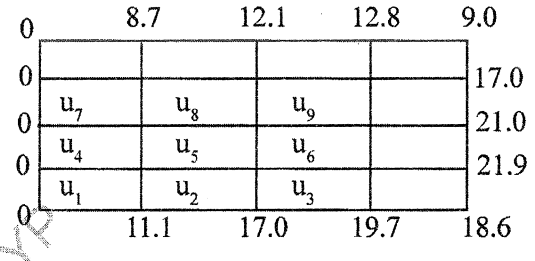
b) Solve the equation $\frac{\partial u}{\partial t} = k\frac{\partial^2 y}{\partial x^2}$ for the conduction of heat along a rod with out radiation subject to the following conditions [8]

i) u is not finite for $t \to \infty$.

ii) $\frac{\partial u}{\partial x} = 0$ when $x = 0$ and $x = l$ for any time t.

iii) $u - lx - x^2$ for $t = 0$ between $x = 0$ and $x = l$.

c) Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the following data. Calculate two iteration. [8]



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R - 135

Total No. of Pages : 3

Seat No.	

S.E. (Chemical) (Part - II) (Semester - IV) Examination, November - 2014

CHEMISTRY - II

Sub. Code : 43657

Day and Date : Thursday, 27 - 11 - 2014 **Total Marks :100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) **Question No. 1 from Section I and question No. 5 from Section II are compulsory.**
2) **Solve any two questions from question No. 2 to 4 from Section I and any two questions from question No. 6 to 8 from Section II.**
3) **Draw neat labeled diagrams wherever necessary.**
4) **Figures to the right indicate full marks.**

SECTION - I

Q1) Write notes on of the following (Any four) **[18]**

a) VBT of coordination compounds

b) Classification of non aqueous solvent.

c) Crystal Field Stabilization Energy of co-ordination compounds.

d) Comparison between non-aqueous solvents and water.

e) Primary standard substances.

f) Sidgwick's model (EAN) of co-ordination compounds.

Q2) a) What is hybridization? Explain hybridization in H_2O, NH_3 and PCl_5. **[8]**

b) Explain Werner's theory coordination compounds. **[8]**

P.T.O.

Q3) a) Explain the manufacture of sulphuric acid by contact process. [8]

b) Explain liquid ammonia as non aqueous solvent. [8]

Q4) a) Define following terms ot explain concentration of solutions.

i) Molarity

ii) Normality

iii) Molality

iv) Equivalent weight [8]

b) i) Calculate the normality and molarity of 10% (w/v) H_2SO_4. [4]

ii) 44 ml of NaOH neutralized 36ml of 0.1N HCL. Find out normality and strength of NaOH. [4]

SECTION - II

Q5) Write short notes on any four of the following: [18]

a) Benzidine rearrangement reaction.

b) Butyl rubber

c) Chemical shift

d) Oxidation and reduction of pyridine

e) Applications of IR spectroscopy.

f) Kolbe's synthesis.

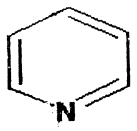
Q6) a) What is catalytic cracking? Explain fixed bead catalytic cracking process with neat labeled diagram. [8]

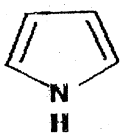
b) Explain basic principle, construction and working of NMR spectrometer. [8]

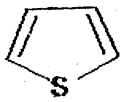
Q7) a) Explain the mechanism of aldol condensation. [5]

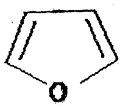
b) What are polymerization techniques? Write merits and demerits of any one technique. [6]

c) What are Heterocycles? Predict the product of the following reactions. [5]

i)  sulphonation → ?

ii)  Nitration → ?

iii)  Gattermann Koch reaction → ?

iv)  Catalytic reduction → ?

Q8) a) Give preparation and chemical properties of pyrrole. [6]

b) Explain process of refining of crude petroleum with a neat diagram. [6]

c) Write short note on 'Buna-S rubber' [4]

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W–728

Total No. of Pages : 2

Seat No.	

S.E. (Chemical) (Part -II) (Semester - IV) Examination, May - 2014

CHEMISTRY - II

Sub. Code : 43657

Day and Date : Saturday, 17 - 05 - 2014 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :

1) **Question no 4 and 8 are compulsory.**
2) **Attempt any two questions each from remaining questions of section - I and section - II.**
3) **Draw neat labelled diagrams wherever necessary.**
4) **Assume suitable data wherever necessary.**
5) **Figures to the right indicate full marks.**

SECTION - I

Q1) a) Explain Crystal Field Theory (CFT) of coordination compounds. [8]

b) Explain the structure and geometry of H_2O and NH_3. [8]

Q2) a) Explain manufacture of ammonia by habers process with respect to reactants, catalyst and physicochemical principles. [8]

b) Explain molecular orbital theory of covalent bonding and explain bonding in H_2 and Li_2. [8]

Q3) a) What is the principle of volumetric analysis? Explain the terminology involved in it. [8]

b) Explain the characteristic properties of non-aqueous solvents. [8]

P.T.O

Q4) Write notes on (any four) : [18]

a) Sidgwicks model of coordination compounds.

b) Contact process.

c) Classification of non-aqueous solvents.

d) Primary standard substancess.

e) SP^3 hybridization.

f) Werners coordination theory.

SECTION - II

Q5) a) What is aldol condensation reaction? Explain its mechanism. [6]

b) Explain the process of moving bed catalytic cracking with a neat diagram. [6]

c) State properties and applications of butadiene. [4]

Q6) a) Distinguish between suspension and emulsion polymerisation. [6]

b) Explain in brief basic principle of IR spectroscopy. [6]

c) Give brief account of Gatterman koch reaction. [4]

Q7) a) Give synthesis and electrophilic substitution reactions of pyridine. [6]

b) State preparation, properties and applications of Teflon. [6]

c) What are the products of reduction of pyrrole and furan? [4]

Q8) Write notes (any four) : [18]

a) Friedal crafts reactions.

b) Bulk polymerisation.

c) Isoquinoline

d) NMR spectra of ethanol

e) Origin and composition of crude oil.

f) Buna-S rubber.

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S-2189

Total No. of Pages : 3

Seat No.	

S.E.(Chemical)(Part - II) (Semester - IV) (Revised)
Examination November - 2015
CHEMISTRY - II
Sub. Code : 63428

Day and Date: Monday, 30-11-2015 **Total Marks : 100**

Time : 10.00 a.m to 01.00 p.m.

Instructions :

1) **Question no.4 and 8 are compulsory.**
2) **Attempt any TWO questions from remaining questions of section 1 and any TWO questions from the remaining questions of section II.**
3) **Draw neat labelled diagrams wherever necessary.**
4) **Assume suitable data wherever required.**

SECTION - I

Q1) a) What is the need of fertilizers? Describe the role of macronutrients in the fertilisers? **[6]**

b) Discuss reactions of liquid ammonia as non - aqueous solvent. **[5]**

c) Explain in details the physico-chemical principles involved in the manufacture of ammonia by Haber's process. **[5]**

Q2) a) Explain physicochemical principles involved in the manufacture of sulphuric acid by contact process. **[6]**

b) What do you mean by ligands? How do they form metal chelates? Explain with suitable examples. **[5]**

c) Discuss the effect of fertilizers. **[5]**

P.T.O.

Q3) a) Explain hydrofluoric acid as non aqueous solvent. **[6]**

b) Give properties and uses of Ammonium Chloride. **[5]**

c) Give in details the classification of fertilizers. **[5]**

Q4) Write short notes on any FOUR. **[18]**

a) Uses of DMG in detection of nickel.

b) Structural requirements of chelate formation.

c) Water as universal solvent.

d) Metal complex and metal chelate.

e) Characteristics of non aqueous solvents.

f) Properties and applications of ferrous ammonium sulphate.

SECTION - II

Q5) a) Explain Solution Polymerization Technique. Give its advantages and disadvantages. **[6]**

b) What is pyrrole? Give oxidation and reduction reactions of pyrrole. **[5]**

c) What is cracking? Explain the process of catalytic cracking. **[5]**

Q6) a) Explain Suspention Polymerization Technique.Give its advantages and disadvantages. **[6]**

b) How is furan synthesized? Give any two reactions of furan. **[5]**

c) What are carbohydrates ? How they are classified? Give examples of each type. **[5]**

Q7) a) What is petroleum? Explain Refining of petroleum. What is its Chemical composition? **[6]**

b) What is polymerization reactions? Explain Addition Polymerization reaction with suitable example. **[5]**

c) How pyridine is obtained? Give any two chemical reactions of pyridine. **[5]**

Q8) Write note on:-(Any four) **[18]**

a) Buna -S Rubber (SBR)

b) Quinoline

c) Poly methyl methacrylates (PMMA)

d) Nucleic acid.

e) Paracetamol.

f) Compounding of plastics.

S-2185

Total No. of Pages : 3

Seat No.	

S.E.(Chemical) (Part-II) Examination, December-2015
CHEMISTRY-II
Sub. Code : 43657

Day and Date:Tuesday, 01-12-2015
Time : 10.00 a.m. to 01.00 p.m. **Total Marks : 100**

Instructions :
1) **Question No. 1 from Section I and question no.5 from Section II are compulsory.**
2) **Solve any two questions from question no.2 to 4 from Section I and any two questions from question no.6 to 8 from Section II.**
3) **Draw neat labeled diagrams wherever necessary.**
4) **Figures to the right indicate full marks.**

SECTION-I

Q1) Write notes on of the following (Any four): **[18]**

a) Reactions involved in Contact process.

b) Liquid HF as non aqueous solvent.

c) Effective Atomic Number.

d) Hybridization in PCL_5.

e) Crystal field stabilization energy.

f) Volumetric analysis.

Q2) a) Explain molecular orbital with bonding in H_2 ,He_2 and Li_2. **[8]**

b) Explain Crystal Field Theory of coordination compounds. **[8]**

P.T.O.

Q3) a) Explain Physico - chemical principles involved in the manufacturing of ammonia by Haber's process. **[8]**

b) Explain the following characteristic properties of non- aqueous solvents. **[8]**

i) M.P. / B.P.

ii) Heat of fusion and vaporization.

iii) Dielectric constant .

iv) Dipole moment

Q4) a) i) 0.80 gms of NaOH is dissolved in 200ml of water. Find out normality and molarity of this solution. **[4]**

ii) Calculate the normality and molarity of 14 % (w/v) H_2SO_4. **[4]**

b) What are the different terms to express the concentrations of solutions? Define each term and explain with examples. **[8]**

SECTION-II

Q5) Write short notes on any four of the following: **[18]**

a) Chemical shift.

b) Claisen rearrangement reaction.

c) Buna rubber.

d) Petrochemicals from benzene.

e) Gattermann koch reaction.

f) Applications of NMR spectroscopy.

Q6) a) Give basic principles, construction and working of IR spectroscopy. **[6]**

b) What is aldol condensation? Explain its mechanism and applications. **[6]**

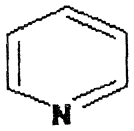
c) Write short note on 'Butyl rubber'. **[4]**

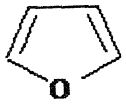
Q7) a) Explain process of refining of crude petroleum with a neat diagram. **[8]**

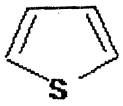
b) What are heterocyclic compounds? Write preparation and properties of pyrrole and furan. **[8]**

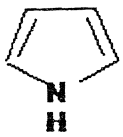
Q8) a) Give comparison between bulk polymerization and solution polymerization. **[8]**

b) Identify and predict the products of the following reactions. **[8]**

i)  $\xrightarrow[363K]{SO_3 \,/\, Pyridine}$?

ii)  $\xrightarrow{Br_2 \,/\, Acetic\ acid}$?

iii)  $\xrightarrow[ii)\ H_2O]{i)\ HCHO \,/\, HCl}$?

iv)  $\xrightarrow{H_2 \,/\, Ni}$?

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SM - 21

Seat No.	

Total No. of Pages : 3

S.E. (Chemical Engg.) (Part - II) (Semester - IV)
Examination, April - 2016
CHEMISTRY - II
Sub. Code : 63428

Day and Date : Wednesday, 20 - 04 - 2016 **Total Marks : 100**

Time : 10.30 a.m. to 01.30 p.m.

Instructions :
1) **Question number 4 and 8 are compulsory.**
2) **Attempt any two questions each from questions of section - I and section - II.**
3) **Draw neat labelled diagrams wherever necessary.**
4) **Assume suitable data wherever necessary.**
5) **Figures to the right indicate full marks.**

SECTION - I

Q1) a) Give detailed account of the manufacture of sulphuric acid by contact process. [6]

b) Explain following properties of non aqueous solvents. [5]

i) Heat of vaporization

ii) Heat of fusion

c) What is the need of fertilizers? Describe role of each macronutrients in the fertilizers. [5]

Q2) a) Explain ammonia as non aqueous solvent. [6]

b) Define the term ligand. How does ligand form metal chelate? Explain with suitable example. [5]

c) What are the properties and applications of DMG? [5]

Q3) a) How do fertilizer causes pollution? Explain with example. [6]

b) Describe Properties and applications of Sodium hydroxide. [5]

c) Explain in details the physico-chemical principles involved in the manufacturing of ammonia by Haber's process? [5]

P.T.O.

t note on (any three) : **[18]**

ɔrties and applications of FAS

ɔlex fertilizers and mixed fertilizers

ɜ non aqueous solvent

ification of fertilizers

l complex and metal chelate

SECTION - II

ıin in detail bulk and solution polymerization techniques. **[6]**

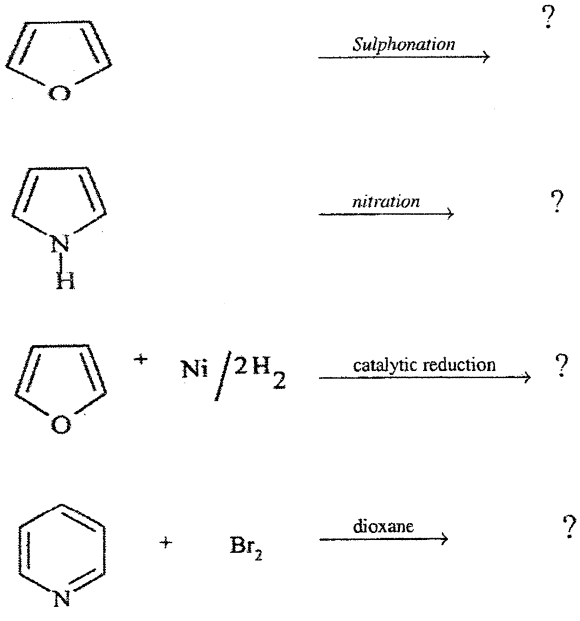
Pyrrole is synthesized? Give any two reactions of pyrrole. **[5]**

rentiate between DNA and RNA. **[5]**

ıin the process of refining of crude oil. State the product obtained ıeir applications. **[6]**

. is compounding of plastics? Which additives are added in the ɔounding of plastics? **[5]**

. are heterocycles? Predict the product of following reactions. **[5]**



Q7) a) What are carbohydrates? How are they classified? Give example of each type. **[6]**

b) What are petrochemicals? State applications of benzene. **[5]**

c) How pyridine is synthesized? Give any two important reactions. **[5]**

Q8) Write short note on (any three) : **[18]**

a) Butyl rubber

b) Octane and Cetane number

c) Aspirin

d) Cracking

e) Emulsion polymerization

SJ - 604

Seat No.	

Total No. of Pages : 3

S.E. (Chemical) (Part - II) (Semester - IV)

Examination, November - 2016

CHEMISTRY - II (Revised)

Sub. Code : 63428

Day and Date : Tuesday, 8 - 11 - 2016

Time : 02.30 p.m. to 05.30 p.m. **Total Marks : 100**

Instructions : 1) **Question no. 4 & 8 are compulsory.**

2) **Attempt any two questions from remaining questions of Section I and any two questions from the remaining questions of Section II.**

3) **Draw neat labelled diagrams wherever necessary.**

4) **Assume suitable data wherever required.**

SECTION - I

Q1) a) Explain physicochemical principles involved in manufacture of sulphuric acid by contact process. **[6]**

b) Explain Hydrofluric acid (HF) as non-aqueous solvent with respect to solvent characteristics and any two important reactions. **[5]**

c) Describe applications of chelation with respect to EDTA. **[5]**

Q2) a) Explain plant and process for manufacture of ammonia by Haber process. **[6]**

b) What is need and essential requirements of fertilizers. **[5]**

c) How will you classify chelating agents. **[5]**

Q3) a) Give preparation of NaOH by electrolytic process & state it's applications. **[6]**

b) State and explain characteristics of non-aqueous solvents. **[5]**

c) Describe fertility and pH value of soil mixed fertilizers. **[5]**

P.T.O.

Q4) Write note on : (Any Four) [18]

a) Differentiate metal chelate and metal complex.

b) Solvolysis.

c) DMG as a chelating agent.

d) Classification of fertilizers.

e) Properties and applications of Ferrous Ammonium Sulphate (FAS)

f) Pollution caused by fertilizers.

SECTION - II

Q5) a) What is the composition of petroleum? Explain the process of refining of petroleum with neat flow sheet. [6]

b) How is pyridine synthesized? Give any two chemical reactions of pyridine. [5]

c) Explain solution polymerization technique give it's advantages and disadvantages. [5]

Q6) a) What is compounding of plastics? What are the additives added in compounding of plastics. [6]

b) What are proteins? Explain secondary structure of proteins. [5]

c) How is pyrrole synthesized? What are the products of oxidation and reduction of pyrrole. [5]

Q7) a) Explain Bulk polymerization technique give it's advantages and disadvantages. [6]

b) What is cracking? Explain the process of moving bed catalytic cracking with a neat diagram. [5]

c) How is quinoline synthesized? Discuss it's important reactions. [5]

Q8) Write note on : (Any Four) [18]

a) Analgesics.

b) Furan

c) Polytetrafluoro ethylene (Teflon)

d) Enzymes as biomolecules

e) Octane number and cetane number

f) Butyl Rubber

SL-599

Total No. of Pages :3

Seat No.	

S.E. (Chemical) (Part - II) (Semester - IV) (Revised) Examination, April - 2017
CHEMISTRY - II
Sub. Code: 63428

Day and Date :Thursday, 27 - 04 - 2017 **Total Marks : 100**

Time :10.00 a.m. to 1.00 p.m.

Instructions :
1) **Question no.4 and 8 are compulsory.**
2) **Attempt any two questions from remaining questions of section I and any two questions from the remaining questions of section II.**
3) **Draw neat lanelled diagrams wherever necessary.**
4) **Assume suitable data wherever required.**

SECTION-I

Q1) a) Explain plant and process for manufacture of ammonia by Haber's process. **[6]**

b) Explain acetic acid as non-aqueous solvent with respect to solvent characteristics and any two important reactions. **[5]**

c) Give classification of fertilizers. **[5]**

Q2) a) What is the importance of solvent in chemical reaction? Explain water as universal solvent. **[6]**

b) Give preparation and applications of ammonium chloride. **[5]**

c) State and explain structural requirements of chelate formation. **[5]**

Q3) a) Differentiate between metal chelate and metal complex. **[6]**

b) Explain physiochemical principles involved in manufacture of sulphuric acid by contact process. **[5]**

c) Describe pollution caused by fertilizers. **[5]**

P.T.O.

Q4) Write note on (Any four): **[18]**

a) Liquid ammonia as non-aqueous solvent.

b) Classification of chelating agent.

c) Complex fertilizers.

d) DMG as a chelating agent.

e) Preparation & applications of sodium hydroxide.

f) Needs and essential requirements of fertilizers.

SECTION-II

Q5) a) Explain the process of refining of petroleum state the products obtained and their applications. **[6]**

b) What is polymerization reaction? Explain suspension polymerization technique give it's advantages and disadvantages. **[5]**

c) How is Furan synthesized? Give any two important reactions of furan. **[5]**

Q6) a) What are carbohydrates? Give classification of carbohydrates and quate one example of each type. **[6]**

b) How is pyridine isolated from coal-tar. **[5]**

c) Explain Emulsion polymerization technique. Give it's advantages and disadvantages. **[5]**

Q7) a) What are nucleic acids? Name and draw structural formula of pyrimidine and pyrine bases and sugar found in nucleic acid. **[6]**

b) How is pyrrole synthesized? Give any two important reactions of pyrrole. **[5]**

c) Give preparation, propertis and applications of polymethyl methacrylates (PMMA). **[5]**

Q8) Write note on (Any Four): **[18]**

a) Compounding of plastics.

b) Protein as Biomolecules.

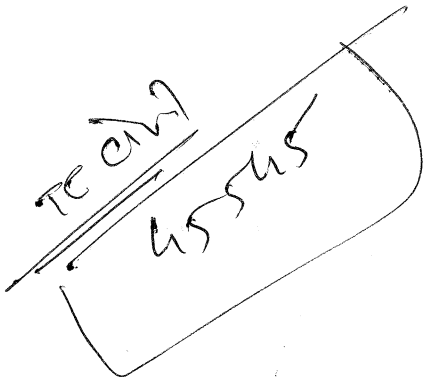
c) Buna - S Rubber (SBR).

d) Sulphanil amides.

e) Lipids.

f) Quinoline.

EEE



SJ - 602

Seat No.	

Total No. of Pages : 2

S.E. (Chemical Engg.) (Semester - III) Examination, November - 2016

MECHANICAL OPERATIONS

Sub. Code : 63425

Day and Date : Friday, 25 - 11 - 2016

Time : 10.30 a.m. to 01.30 p.m. **Total Marks : 100**

Instructions : 1) Attempt three questions from each section.

2) Right side of question indicate full marks.

3) Assume suitable data, if necessary.

SECTION - I

Q1) a) Define average particle size, specific surface area, sphericity and explain their significance. **[8]**

b) State and explain Bonds law and work index. **[8]**

Q2) a) Describe a gyratory crusher with a neat sketch and applications. **[8]**

b) Compare open and closed circuit grinding. **[8]**

Q3) a) Calculate the critical speed of a ball mill from the following data,
Data : Diameter of a ball mill = 500 mm,
Diameter of balls = 50 mm. **[8]**

b) Explain a ball mill with a neat sketch and the effect of [materials / balls] ratio. **[8]**

Q4) Write short notes on any three. **[3 × 6 = 18]**

a) Impact mill

b) Grizzley

c) Rotary screen

d) Four basic principles of size reduction and examples.

e) Belt conveyor.

f) Storage of solid particles.

P.T.O.

SECTION - II

Q5) a) State the three main groups of filters and explain the mechanisms of filtration with a neat sketch. **[9]**

b) What are the different materials used for filter mediums? Also write down the properties required by a filter medium. **[8]**

Q6) a) Describe the mechanism of flocculation. **[8]**

b) Explain the Kynch theory of sedimentation. **[9]**

Q7) a) Explain the forth flotation. **[8]**

b) Explain the Jigging. **[8]**

Q8) a) State the main reasons of removing particles from an effluent gas. **[8]**

b) Describe the Cyclone separators & its industrial applications. **[8]**

S-2191

Total No. of Pages : 3

Seat No.	

S.E. (Chemical) (Revised)(Semester-IV) Examination,December-2015
HEAT TRANSFER
Sub. Code : 63430

Day and Date : Wednesday, 2-12-2015 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) **Solve any three questions from each section.**
2) **Assume suitable data if required.**
3) **Draw neat diagrams wherever necessary.**

SECTION-I

Q1) a) State and explain fourier's law and derive equation for heat transfer rate through the sphere. **[8]**

b) A brick work of furnace is built-up of layers laid of the fire clay brick (k1=0.270 W/m °C, thickness=25cm) & red bricks(k2= 0.97 W/m °C,thinkess=45cm) The space between two layers is filled with diatomaceous earth(k3=0.10w/m °C, thickness=6cm) If brick work is to be done without diatomaceous earth filling and temperature on both sides of wall is to be remain same, calculate additional thickness of fire clay brick required that will give same heat flux. **[8]**

Q2) a) Derive equation for LMTD in counter flow arrangement. **[8]**

b) Explain enthalpy balance for heat exchanger and condenser. **[8]**

Q3) a) Define individual heat transfer coefficient and overall coefficient, Explain calculation of surface heat transfer coefficient in forced convection for laminar flow, transition region and turbulent flow. **[8]**

b) Water flows through a 22 mm ID pipe having length 10 m, at a velocity 0.020 m/s.The water enters at 30°C & the pipe surface is maintained at 100°C by means of condensing steam. calculate outlet temperature of water.

Properties of water: ρ=998 kg/m^3, μ =0.86cp, k=0.46 W/m°C, Cp=4184J/kg°C **[8]**

P.T.O.

Q4) Solve any three. **[18]**

a) Explain calculation of time required for heating or cooling of slab and cylinder in unsteady state conduction.

b) With suitable example explain the natural convection.

c) What is fouling factor? How is taken in to account in calculation of overall coefficient?

d) Expalin calculation of average heat transfer coefficient for forced convection in turbulent flow through the tube.

e) Explain thermal and hydrodynamic boundary layer and importance of prandtl number.

SECTION-II

Q5) a) Discuss types of reflection and radiation between two black surfaces. **[8]**

b) Calculate average h,t,c Local h.t.c at 50 cm height and a film thickness at 500mm height for a vertical tube where the saturated steam at 80 °C.condenses on plate of 100 cm height at a temperature of 70 °C.

Data: $\rho 1=974.8 kg/m^3$ $\mu l=380.5 \times 10^{-6}$ Ns/m² λ =2300 kJ/kg **[8]**

k=0.6715 w/m °C

Q6) a) Whyboiling equipments should be operated below critical temperature drop? Discuss boiling curve with types of boiling. **[8]**

b) A solution of organic solution in water is to be concentrated from 10% to 50% solids by weight. steam is available at 1.013 bar a pressure of 102 mm of Hg(abs) is to be maintained in vapor space if the feed rate of evaporator is 24950 kg/hr and overall heat transfer coefficient is 2800W/ m² °C. calculate steam consumption economy and heat transfer area required if the feed temperature is 51.7 °C neglect BPR and heat of barriation.

Data: Heat capacity of feed=3.7kJ/kg °C

Temperature of steam corresponding 1.013 bar=Ts100°C and λs=2258kJ/kg.

Temperature of solution corresponding102mm Hg=Tsat=51.7°C and λv=2378.8kJ/Kg. **[8]**

Q7) a) A DPHE is to be designed to cool a solution from 82°C to38°C water enters the annular space at 21°C and flows counter current to solution at 1.63m/s the pipe comes in 6.536m sections how many sections in series must be used to cool the solution at 3.375 kg/s neglect dirt resistance.

Data: I.D. of inner pipe=di=3.505cm

O.D of inner pipe=do=4.216 cm

I.D of outer pipe=Di=5.25cm **[10]**

Property	Solution	Water	Units
μ	0.39×10^{-3}	0.8×10^{-3}	kg/m-s
Cp	1881	4.18×10^{3}	J/kg °C
ρ	837.74	1000	kg/m^3
k	0.159	0.59	W/m°C

b) Discuss heat transfer to packed bed heat exchanger. **[6]**

Q8) Write short notes on any three: **[18]**

a) Extended surface heat exchanger.

b) Laws of radiation.

c) Performance of steam heated evaporators.

d) Effect of non condensable gases on the rate of condensation.

SJ - 606

Total No. of Pages : 3

Seat No.	

S.E. (Chemical) (Semester - IV) (Revised) Examination, November - 2016

HEAT TRANSFER

Sub. Code : 634430

Day and Date : Thursday, 10 - 11 - 2016 **Total Marks : 100**

Time : 02.30 p.m to 05.30 p.m.

Instructions : 1) Answer any three questions from each section.

2) Assume suitable data if required

3) Draw neat diagrams wherever necessary.

SECTION - I

Q1) a) Derive equation for heat transfer rate through the compund cylinder having three layers in series and length 'L' and temperature drop across cylinder is ΔT. [8]

b) A furnace wall made up of steel plate 4 cm thickness (k = 42 w/m°C) lined on inside with silica brick 25 cm thick, (k = 1.2 w/m °C) & on outside with magnesite brick 30 cm thick, (k = 2.5 w/m°C). Inside temp. of wall is 900°C & on outside 30°C. Calculate, [8]

i) Rate of heat flow through wall.

ii) Interface temp.

iii) If the heat flow is to be reduced to 60% by means of air gap between steel plate and magnesite brick, calculate width of air gap required.

Q2) a) Define individual and overall coefficient and show that overall resistance is addition of individual resistances. [8]

b) Benzene is flowing at a rate 15 tons/hr through the inner pipe of a double pipe heat exchanger is to be cooled from 85°C to 42°C using water at 22°C. The water side coefficient is 2200 watt/m^2 °C & Benzene side coefficient is 1200 watt/m^2 °C. Calculate, [8]

P.T.O.

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Total No. of Pages : 4

Seat No.	

S.E. (Chemical Engg.) (Revised) (Semester - IV) Examination, December - 2014

CHEMICAL ENGINEERING AND THERMODYNAMICS - I

Sub. Code : 43660

Day and Date : Monday, 1 - 12 - 2014 **Total Marks :100**

Time : 10.00 a.m. to 1.00p.m.

Instructions : 1) **Answer any three questions from each section.**

2) **Assume suitable data if necessary.**

3) **Draw neat diagram wherever necessary.**

SECTION - I

Q1) a) Explain state functions and path functions with suitable examples. [8]

b) The reading on a mercury manometer at 298°k. (open to the atmosphere at one end) is 56.38 cm. The local acceleration of gravity is 9.832 m/s^2. Atmospheric pressure is 101.78 kpa. What is the absolute pressure in kpa is being measured ? The density of mercury at 298.15°k = 13.534 gm/cm^3. [8]

Q2) a) State and explain first law of thermodynamics. derive the mathematical equation for it. [8]

b) A steel casting weighing 2 kg has an initial temperature of 773.15k (500°C). 40 kg of water initially at 298.15 k (25°C) is contained in a perfectly insulated tank weighing 5 kg. The casting is immersed in water and the system is allowed to come equilibrium. What is the final temperature? Ignore any effect of expansion or contraction and assume constant specific heats of 4 -18 KJ/kg k for water and 0.5 KJ/ kg k for steel tank. [8]

P.T.O.

Q3) One mole of an ideal gas with $Cp=\frac{7}{2}R.$ and $Cv=\frac{5}{2}R.$ expands from P_1=8 bar and $T_1=600K$ to $P_2=1$ bar by each of the following paths.

a) Constant volume

b) Constant temperature

c) Adiabatically

Assuming mechanical reversibility calculate $W, Q, \Delta U$ and ΔH for each process. Sketch each path on a single PV diagram. **[16]**

Q4) Write short notes on the following (Any Three) **[3×6=18]**

a) Thermodynamic systems.

b) Second law of thermodynamics.

c) Cubic equation of state

d) Clausius - Clayepyron equation

e) Effect of temperature on heat of reaction.

SECTION - II

Q5) a) State and prove carnots theorem? Mention the assumptions made? [8]

b) A 40 kg steel casting ($Cp = 0.5$ KJ kg^{-1} k^{-1}) at a temperature of 723.15k is quenched in 150 kg of oil $\left(Cp=2.5KJ\ Kg^{-1}K^{-1}\right)$ at 298 K. If there are no heat losses, what is the change in entropy of

i) The casting

ii) The oil and

iii) Both considered together [8]

Q6) a) Show that the gibbs energy as a generating function for various thermodynamic properties. [8]

b) The mean heat of vapourisation of water the temperature range between 90°C and 100°C is 542 cal/gm. Calculate the vapour pressure of water at 90°C, the value of 100°C being 76cm? [R = 1.987 cal/gm. mole k] [8]

Q7) a) What are the practical limitations of a carnot cycle for refrigeration and how are those overcome in a vapour compression refrigeration cycle.[8]

b) A diesel engine operates with a compression ratio of 15. The pressure and the temperature at the beginning of the compression strokes are 100kpa and 300k. Heat is transferred at the rate of 500 KJ/kg of the working fluid per cycle. Determine the following.

(Take Cp=1.005 KJ/Kg k and Cv = 0.718KJ /Kg k) [8]

i) The pressure & temperature at each stage of the cycle

ii) The thermal efficiency.

Q8) Write short notes on : (Any Three). **[3×6=18]**

a) Second law of thermodynamics.

b) Maxwell Relations.

c) Regenerative Cycle.

d) Selection of Refrigerant.

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S - 2490

Total No. of Pages : 3

Seat No.	

S.E. (Chemical Engineering) (Semester - IV) (Revised) Examination, December - 2015

CHEMICAL ENGINEERING THERMODYNAMICS - I

Sub. Code : 63431

Day and Date : Thursday, 03 - 12 - 2015 **Total Marks : 100**

Time : 10.00 a.m. to 01.00 p.m.

Instructions : 1) Answer any three questions from each section.

2) Assume suitable data if necessary.

3) Draw neat diagram wherever necessary.

SECTION - I

Q1) a) Define Thermodynamic state and explain different thermodynamic processes with suitable examples. **[8]**

b) The potential energy of a body of mass 20 kg is 3.5 KJ. What is the height of the body from the ground? If a body of mass 20 kg is moving at a velocity of 50 m/s, What is its Kinetic energy? A car having a mass of 1200 kg is running at a speed of 60 km/hr. What is the Kinetic energy of the car in KJ? What is the work to be done to bring the car to a stop? **[8]**

Q2) a) Derive an expression for first law of thermodynamics for a non flow process. **[8]**

b) Define and state phase rule? How many degrees of freedom has each of the following systems? **[8]**

i) Liquid Water in equilibrium with its vapour?

ii) Liquid Water in equilibrium with a mixture of Water vapour and nitrogen?

iii) Liquid solution of alcohol in water in equilibrium with its water.

P.T.O.

Q3) a) Derive an expression for virial equation of state? Give its applications? **[8]**

b) One cubic meter of an ideal gas at 500K and 2000KPa expands to 10 times its initial volume as follows -

i) by a mechanically reversible Isothermal process.

ii) by a mechanically reversible adiabatic process.

iii) by an adiabatic irreversible process in which expansion is against a restricting pressure of 100 KPa. For each case calculate the final temperature, pressure and the work done by the gas.

Data : $C_p = 21$ J/mol. k. **[8]**

Q4) Write short notes on : (Any three) **[18]**

a) Reversible and Irreversible process.

b) Vander Waals equation of state.

c) Heat capacity at constant volume and pressure process.

d) Intensive and Extensive properties.

SECTION - II

Q5) a) Explain in brief the concept of entropy? Also derive an expression for entropy? **[8]**

b) A particular power plant operates with a heat source reservoir at 623.15k(350°C) and a heat sink reservoir at 303.15k(30°C). It has a thermal efficiency equal to 55% of the carnot engine thermal efficiency for the same temperatures.

i) What is the thermal efficiency of the plant?

ii) To what temperature must the heat source reservoir be raised to increase the thermal efficiency of the plant to 35%? Again η is 55% of the carnot engine value. **[8]**

Q6) a) Derive Max well relations and mention its applications. **[8]**

b) Prove that -

i) $dH = CpdT + \left[V - T\left(\frac{\partial V}{\partial T}\right)_p\right]dp$

ii) $ds = Cv\ \frac{dT}{T} + \left(\frac{\partial P}{\partial T}\right)_V dV$ **[8]**

Q7) a) Derive an expression for thermal efficiency η for an otto engine cycle? **[8]**

b) A refrigeration machine operating at a condenser temperature of 290 k needs 1 KW of power per ton of refrigeration. Determine the following -

i) The coefficient of performance.

ii) The heat rejected to the condenser.

iii) The lowest temperature that can be maintained. **[8]**

Q8) Write short notes on : (Any three) **[18]**

a) Cornot's theorem

b) Fundamental property relations

c) I.C. engine

d) Choice of Refrigerant

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Seat No.	

Total No. of Pages 4

S.E. (Chemical) (Semester - IV)Examination , May -2014

CHEMICAL ENGINEERING THERMODYNAMICS - I (Revised)

Sub. Code :43660

Day and Date :Saturday, 24- 05 - 2014 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : **1)** **Answer any three questions from each section.**

2) **Assume missing data if any.**

3) **Draw the neat diagrams wherever necessary.**

SECTION - I

Q1) a) Describe the Joule's experiment to understand the concept of Internal energy. **[8]**

b) A gas is confined in a 0.47m diameter cylinder by a piston. on which rests a weight. The mass of the piston and weight together is 150 kg. The local acceleration of gravity is 9.813m/s^2 and atmospheric pressure is 101.57 kpa.

i) What is the force in Newtons exerted on the gas by the atmosphere, the piston and the weight, assuming no friction between the piston and cylinder.

ii) What is the pressure of the gas in kpa?

iii) If the gas in the cylinder is heated, it expands pushing the piston and weight upward. If the piston and weight are raised by 0.83m. What is the work done by the gas in KJ? What is the change in potential energy of the pistion and weight? **[8]**

Q2) a) Deduce the virial equation of state and mention its applications. **[8]**

b) In the following take Cv=20.8 and Cp = 29.1 J/mol.°C for nitrogen gas.

i) Three moles of nitrogen at 30°c (303.15k). contained in a rigid vessel is heated to 250°c (523.15k) How much heat is required if the vessel has a negligible heat capacity? If the vessel weights 100kg and has a heat capacity of 0.5 KJ/kg°c, how much heat is required?

P.T.O.

ii) Four moles of nitrogen at 200°c (473.15k) is contained in a piston / cylinder arrangement. How much heat must be extracted from this system, which is kept at constant pressure to cool it to 40°c (313.15k) if the heat capacity of the piston and cylinder is neglected? **[8]**

Q3) a) Explain in brief sensible heat effects and temperature dependence of the heat capacity. **[8]**

b) One cubic meter of an ideal gas at 500 k and 2000 kpa expands to 10 times its intial volume as follows . **[8]**

i) by a mechanically reversible Isothermal process.

ii) by a mechanically reversible adiabatic process.

iii) by an adiabatic, irreveresible process in which expansion is against a restricting pressure of 100 kpa

For each case calculate the final temperature, pressure and the work done by the gas. **[8]**

Data : Cp = 21 J/mol k

Q4) Write short notes on (any three) **[18]**

i) Reversible and Irreversible process.

ii) Intensive and Extensive properties.

iii) Redlich kwong and peng Robinson's equation of state.

iv) Standard heat of combustion

SECTION - II

Q5) a) State and explain the second law of thermodynamics and concept of Carnot engine? **[8]**

b) An ideal gas, Cp=(7/2)R, is heated in a steady-flow heat exchanger

from 343.15K to 463.15 by another stream of the same ideal gas which enters at 593.15 K. The flow rates of the two streams are the same, and heat losses from the exchanger are negligible **[8]**

i) Calculate the molar entropy changes of the two gas streams for both parallel and countercurrent flow in the exchanger?

ii) What is ΔS total in each case?

Q6) a) Wet steam at 503.15°K has a density of 0.025 g/cm^3. Determine x,H, and S. **[8]**

Data : At 503.15K

Phase	Volume cm^3/gm	Enthalpy J/g	Entropy J/gmK
Liquid	1.209	990.3	2.6102
Vapour	71.45	2802.0	6.2107

b) Derive fundamental property relation for residual properties applicable to fluids of constant compositions **[8]**

Q7) a) A refrigeration system requires 1.5 kW of power for a refrigeration rate of 4 kW. **[9]**

i) What is the coefficient of performance?

ii) How much heat is rejected in the condenser?

iii) If heat rejecton is at 313.15K (409C), what is the lowest temperature the system can possibly maintain?

b) Describe with neat sketch working of Otto engine based air standard Otto cycle. **[7]**

Q8) Write short notes on the following (any three) **[18]**

i) Entropy change of an ideal gas

ii) Choice of refrigerant

iii) Thermeodynamic diagrams

iv) Liquefaction process

v) Steam power plant

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S-518

Total No. of Pages : 3

Seat No.	

S.E. (Chemical Engg.) (Semester - IV) (Old) (Revised) Examination, May - 2015

CHEMICAL ENGINEERING THERMODYNAMICS - I

Sub. Code : 43660

Day and Date : Thursday, 14 - 05 - 2015 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) **Answer any three questions from each section.**
2) **Assume suitable data if any.**
3) **Draw neat diagram wherever necessary.**

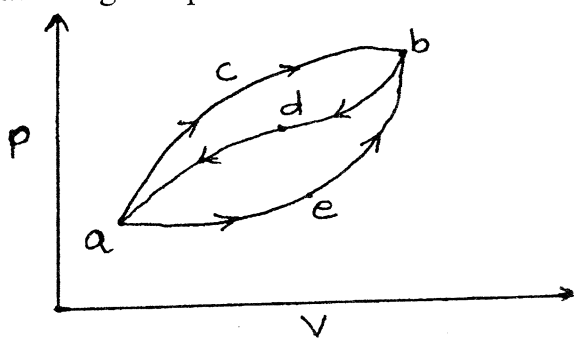
SECTION - I

Q1) a) Explain in brief the Joule's experiment to understand the concept of Internal energy with neat diagram? **[8]**

b) The reading on a mercury manometer at 298.15K(25 °C) (Open to the atmosphere at one end) is 56.38cm. The local acceleration of gravity is 9.832 m/s^2. Atmospheric pressure is 101.78 kPa. What is the absolute pressure in kPa being measured? The density of mercury at 298.15 K (25 °C) is 13.534 g/cm^3. **[8]**

Q2) a) What are intensive and extensive properties explain with suitable examples? **[8]**

b) When a system is taken from state a to state b in figure shown, along path acb, 100J of heat flows into the system and the system does 40J of work. How much heat flows into the system along path aeb if the work done by the system is 20J? If the system is returned from b to a along path bda, the work done on the system is 30J. Does the system absorb or liberate heat along this path? How much? **[8]**



P.T.O.

Q3) a) Explain in brief PVT behaviour of pure substance with PT and PV diagrams. **[8]**

b) One mole of an ideal gas with Cp = (7/2) R, Cv = (5/2)R expands from P_1 = 8 bar and T_1 = 600K to P_2 = 1 bar by each of the following paths.

i) Constant volume

ii) constant temperature

iii) adiabatically

Calculate:

W, Q, $\Delta U \& \Delta H$ for each process. **[8]**

Q4) Write short Notes on (Any Three): **[18]**

a) Reversible and Irreversible processes.

b) State functions and path functions.

c) Virial equation and its applications.

d) Standard heat of combustion & formation.

SECTION - II

Q5) a) State and explain the statements of the second law of thermodynamics. Also derive mathematical statement of the second law ΔS total≥ 0. **[8]**

b) The heat engine produces power of 95000KW. Determine in each case the rates at which heat is absorbed from the hot reservoir and discarded to the cold reservoir. **[8]**

i) A carnot engine operates between heat reservoirs at 750K and 300K.

ii) A practical engine operates between the same heat reservoirs but with a thermal efficiency = $\eta = 0.35$.

Q6) a) Derive clausius clapeyron equation for vapour liquid equilibrium? Mention its applications? **[8]**

b) Derive the following expressions: **[8]**

i) $du = C_V dT + [T(\partial p/\partial T)_V - p]dV$

ii) $ds = C_V dT + [(\partial p/\partial T)_V]dV$

Q7) a) Derive an equation for Cop of carnot refrigerator in terms of cold reservoir temperature T_C and hot reservoir temperature T_H. **[8]**

b) In a carnot cycle heat is supplied at 350°C and is rejected at 25°C. The working fluid is water which receives heat at 350°C evaporates to dry and saturated state at 350°C. The change in entropy during the process is 1.4377 kJ/kg.k. If the cycle operates on a mass of 1kg of water, find the heat supplied, heat rejected. Work done per cycle & cycle efficiency? **[8]**

Q8) Write Short Notes on (Any three): **[18]**

a) Concept of entropy.

b) Thermodynamic diagrams.

c) Liquifaction process.

d) Choice of refrigerant.

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Total No. of Pages : 4

Seat No.	

S. E. (Chemical) (Part - II) (Semester - IV) Examination, November - 2014

PROCESS CALCULATIONS

Sub. Code : 43658

Day and Date : Friday, 28 - 11 - 2014 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) Assume suitable data if necessary.

2) Answer any three questions from each section.

SECTION - I

Q1) a) Small animals such as mice can live at reduced air pressure down to 20k pa. in a test a mercury manometer attached to a tank reads 64.5 cm Hg. and the barometers reads 100 kpa. Will the mice Survive? **[8]**

Note : Mice will live at reduced pressure down to 20kpa but not comfortably.

b) If Dibromopentane (DBP) has a specific gr. of 1.57 what is density in. **[8]**

i) g/cm^3

ii) kg/m^3

iii) lbm/ft^3

Q2) a) A medium grade coal analyzes as follows. **[9]**

Component	S	N	O	ash	water
%	2	1	6	11	3

The residum is C and H in the mole ratio. H/C = g. Calculate the Weight fraction composition of coal with ash and moisture free.

P. T. O.

b) You have 25 kg of a gas of the following composition. [8]

Component	CH_4	C_2H_4	C_2H_6
% Composition	80	10	10

Calculate :

i) Avg. mol. wt. of mixture.

ii) Wt. fr. of each component in the mixture.

Q3) a) The liquid mixture of n-butane, 1-butane and furfural is boiled at 338 k and 0.57 Mpa.g. The mole fr.of n-butane in a ternary Vapor mixture in equlibrium with the liquid is found to be 49.1% (Volume). Assuming ideal behaviour of the liquid and vapor mixtures, find the composition of the vapor mixture. [8]

Data : Vapor pressure of furfural at 338 k = 3.293 kpa (24.7 torr).

mole fr. of furfural in liquid mixture = 0.7738.

b) A weight of 100 g each of HNO_3 and H_2SO_4 is filled in two separate bottles. Which bottle contains more atoms? How many more? [8]

Q4) a) It is required to make 1000 kg mixed acid (M.A.) containing 60% H_2SO_4, 32% HNO_3 and 8% H_2O by blending [9]

i) Spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O,

ii) aq. 90% HNO_3 and

iii) aq. 98% H_2SO_4 (by wt.)

Calculate the quantities of each of the three acids required for blending.

b) Soyabean seeds are extracted with hexane in batch extractors. The flaked seed contain 18.6% oil, 69% solids and 12.4 % moisture. At the end of the extraction process, deoiled cake is separated from the hexane oil mixture. The cake yields 8.0% oil. 87.7% solids and 11.5% moisture. Find the % recovery of oil. All % are by weight. [8]

SECTION - II

Q5) a) In the process of manufacture of HCl, from common salt and H_2SO_4, the two components are heated together in a retort. The HCl gas coming out is cooled and absorbed in H_2O to produce 31.5% HCl by weight. Some amount of HCl is lost during absorption. **[12]**

To produce 1 tonne of 31.5% HCl, a retort is changed with 550 kg of NaCl and 480 kg of 98% H_2SO_4. The reaction is allowed to go to completion.

i) Which is limiting reactant

ii) What is % of HCl formed is lost during absorption?

iii) Calculate the composition and quantity of residue left in the retort assuming that 50% of the water distills over.

[6]

b) Define :

i) % excess reactant

ii) % conversion

iii) Limiting reactant

Q6) a) Tin is melted in an open pan using jacket. The jacket is fed with the vapors of an eutetic mixture of diphenyl-diphenyl oxide at 171 kPa. Tin is fed to the pan at 303k. Calculate the quantity of eutetic mixture of diphenyl - diphenyl oxide condensed per 100 kg of tin melted at its melting temperature. **[8]**

Data : for Tin

Mol. wt = 118.7 Melting point = 505 k

Latent heat of fusion λf = 7201 KJ/K mol

Heat capacity of sold tin = 21.14 + 0.02 T KJ/KmoleK

Latent heat of diphenyl - diphenyl oxide = 278 KJ/kg

b) Calculate the heat of reaction at 298 K **[8]**

$$3CaSO_4(s) + SiO_2(s) \rightarrow 3\ CaOSiO_2(s) + 3SO_2(g) + \tfrac{3}{2} O_2(g)$$

Data :

Component :	$CaSO_4(s)$	$SiO_2(s)$	$3CaOSiO_2(s)$	$SO_2(g)$	$O_2(g)$
ΔH_f° at 298 K : (KJ/kmol)	–1432.7	–903.5	–2879.0	–296.81	0

Determine the given reaction is exothermic or endothermic.

Q7) a) A fuel gas constitutes of CO_2: 3.4%, C_2H_4 : 3.7% C_6H_6 :1.5%, O_2: 0.3%, CO: 17.4%, H_2 : 36.8%, CH_4 : 24.9%, and N_2 : 12% (mole basis). It is burnt with air in a furnace. The analyser indicated 10.0% mole CO_2 (dry basis) in flue gases find : **[8]**

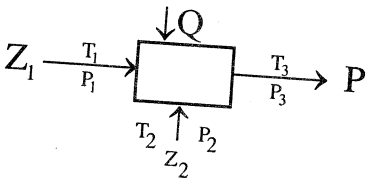
i) % excess air used

ii) the complete orsal - analysis.

b) The proximate analysis of n coal shows. Moisture 5.3%, VM 24.6%, Fc 49.8% and ash 20.3%. The Sulfur content of the coal is found to be 0.7%. The GCV of the coal on dry ash free basis as 24070KJ/kg. Using calderwood equation, find the carbon percent of the coal. **[8]**

Q8) a) Define the number of degrees of freedom. What kind of constrains are involved in the analysis of the degrees of freedom? **[8]**

b) Determine the number of degrees of freedom for the mixer shown in fig. 1. **[8]**



Seat No.	

SJ - 605

Total No. of Pages : 3

S.E. (Chemical Engineering) (Part - II) (Semester - IV) (New Course)

Examination, November - 2016

PROCESS CALCULATIONS

Sub. Code : 63429

Day and Date : Wednesday, 09 - 11 - 2016

Time : 02.30 p.m. to 05.30 p.m. **Total Marks : 100**

Instructions : 1) Attempt any three questions from each section.

2) Assume suitable data if necessary.

SECTION - I

Q1) a) The diameter and height of vertical cylindrical tank are 5 ft and 6 ft 6 inch respectively. It is full up to 75% height with water whose density is 1 kg/l. Find the mass in Kg and pound. **[8]**

b) Calculate the available nitrogen content of the following : **[8]**

i) Commercial ammonium Sulphate (96% pure)

ii) Pure sodium nitrate (100% pure)

Q2) a) A solution of caustic soda contains 20% NaOH by mass. Taking the density of the solution as 1 .196 kg/l. Find the normality, molality and molarity of the solution. **[9]**

b) A mixture of N_2 and CO_2 at 298 K and 101.325 kPa has average molecular weight of 31. What is partial pressure of N_2 and CO_2? **[8]**

Q3) A solution contains 55% benzene, 28% toluene and 17% xylene by mole at 373K. The vapors are in contact with solution. Calculate totai pressure of vapor in a mixture and molar composition of vapors. **[9]**

Data :

Component	Vapor pressure at 373 K (kPa)	Molecular weight
Benzene	178.65	78
toluene	74.66	92
xylene	28	106

b) A production of 5000 kg mixed acid containing 55% H_2SO_4, 35% HNO_3 and 10% water by blending **[8]**

i) the spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O,

ii) aqueous 88% HNO_3 and

iii) aqueous 97% H_2SO_4. All percentages are by weight.

Calculate quantities of each of the three acids required for blending.

Q4) a) Soybean seeds are extracted with hexane in batch extractor. The flaked seeds are found to contain 18.6% oil, 69.6% solid and 12.4% moisture (all by weight). At the end of extraction process, meal is separated from hexane oil mixture and it is analyzed to contain 0.8% oil, 87.7%solid and 11.5 % moisture. Find percentage loss of oil. **[8]**

b) The feed water to reverse osmosis plant has dissolved solids to be extent of 2500 mg/l. The feed to product ratio is 4:3 on weight basis. The treated water to plant contains 300 mg/l of solids. Find the dissolved solids in reject stream. **[8]**

SECTION - II

Q5) a) In manufacturing of chlorine, feed containing hydrochloric acid gas & air are fed to an oxidizer. The product gases leaving the oxidizer are found to contain 13.2% HCl, 6.3% O_2, 42.9% N_2, 30% Cl_2 & 7.6% H_2O (by weight) Calculate : **[9]**

i) the percent excess air used

ii) composition by weight of gases entering the oxidizer &

iii) degree of completion of oxidation.

b) 100kg/h of methanol liquid at a temperature of 303 K (30°C) is to obtained by removing heat from saturated methanol vapour. Find out the amount of heat to be removed in this case. **[7]**

Data : Boiling point of methanol = 337.8 (64.8°C)

Latent heat of condensation of methanol = 1101.7 kJ/kg

Specifice heat of methanol = 2.7235 kJ/(kg.K)

Q6) A natural gas has the following composition on mole basis : **[18]**

CH_4 = 84%, C_2H_6 = 13%, and N_2 = 3%

Calculate the heat to be added to heat 10 kmol of natural gas 298 K(25°C) to 523K(250°C) using heat capacity data given below:

$C^\circ_p = a + bT + cT^2 + Dt^3$, kJ/(kmol. K)

Gas	a	b × 10^3	c × 10^6	d × 10^9
CH4	19.2494	52.1135	11.973	–11.3173
C_2H_6	5.4129	178.0872	–67.3749	8.7147
N_2	29.5909	–5.141	13.1829	–4.968

Q7) a) Calculate enthalpy change between reactant & products if both are at 298 K & if 10 mol of formaldehyde is produced due to following reaction : $CH_{4(g)} + O_{2(g)} \rightarrow HCHO_{(g)} + H_2O_{(g)}$

Data : H°_c(HCHO)g = –563.46 kJ/mol : H°_c(CH4)g = – 890.65 kJ/mol **[8]**

b) Calculate the standard heat of formation of chloroform gas from its element using Hess's law. **[8]**

Data :

$C(s) + O_{2(g)} \rightarrow CO_2(g)$ $\quad \Delta H_1 = -393.51$ KJ/mol

$H_2(g) + ½O_2 \rightarrow H_2O$ $\quad \Delta H_2 = -285.83$ KJ/mol

$½H_2(g) + ½Cl_2(g) \rightarrow HCl(aq)$ $\quad \Delta H_3 = -167.57$ KJ/mol

$CHCl_3 + ½O(g) + H_2O \rightarrow CO_{2(g)} + 3HCl(aq)$ $\quad \Delta H^\circ_C = -509.95$ KJ/mol

Q8) a) calculate the net calorific value(NCV) at 298 K (25°C) at a sample of a fuel oil having C/H ratio 9.33 (by weight) and containing sulphur to the extent of 1 .3% by weight.

Data:

GCV of the fuel oil at 298K (25°C) = 41785kJ/kg,

Latent heat of vapour at 298K (25°C) = 2442.5kJ/kg **[8]**

b) A furnace is fired with fuel oil. The orsat analysis of the fuel gases (by volume) is as given below: CO_2: 10.6%, O_2 : 6% and N_2 :83.4%

Calculate the percentage excess air and find the C : H ratio in the fuel oil, assuming that fuel does not contain nitrogen. **[8]**

S-520

Total No. of Pages : 4

Seat No.	

S.E. (Chemical Engg.) (Semester - II) (New Course) Examination, May - 2015

PROCESS CALCULATIONS

Sub. Code : 63429

Day and Date : Thursday, 07 - 05 - 2015 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : **1)** **Assume suitable data, if necessary.**

2) **Answer any three questions from each section.**

SECTION - I

Q1) a) The flow rate of H_2O through a pipe is reported as 15 ft^3/min. Calculate mass flow rate in kg/s. Take density of H_2O = 1.0g/cm^3. **[8]**

b) A compound whose molecular weight is 103 analyzes as following: **[8]**

Component	C	H	N
% wt	81.5%	4.9%	13.6%

What is formula?

Q2) a) 10kg of liquid A of Sp. Gravity 1.17 is mixed with 5 kg of liquid B of Sp. Gravity 0.83. Assuming that there is no volume change on mixing, what is the density & Sp. Gravity of mixture? **[8]**

b) The solubility of NaCl in H_2O at 290 K is 35.8kg/100 kg of H_2O. Express the solubility as the following: **[10]**

i) mass fr & mass % of NaCl

ii) mole fr & mole % NaCl

iii) kmol NaCl per 1000kg H_2O

P.T.O.

Q3) a) Pure H_2O and Alcohol are mixed to get a 60% (wt) alcohol solution. The densities (kg/m^3) of H_2O, alcohol & the solution may be taken as 998, 798 & 895 respectively at 293K. **[8]**

Calculate:

i) % volume of alcohol

ii) molarity

iii) Molality

b) A ternary mixture of n-butane, I-butene and furfural is analyzed to find the content of each in it. The liquid mixture is boiled at 338.15K (65°C) and 5.7 bar.g. The mole fraction of n-butane in the ternary vapour mixture in equilibrium with the liquid is found to be 49.1 volume %. Assuming ideal behavior of the liquid and vapour mixture, find the composition of the vapour mixture. **[8]**

Data: Vapour pressure of furfural at 338.15 K = 3.293 kPa.

Mole fr of furfural in solution = 77.37%

Q4) a) Two engineers are calculating the Mavg of a gaseous mixture containing oxygen & other gases. One of them using correct molecular weight of 32 for oxygen, determine the Mavg = 39.2. The other using an incorrect value of 16, determines the Mavg = 32.8. This is only error in his calculations. What is % mole of oxygen in the mixture. **[8]**

b) It required to make 1000kg mixed acid containing 60% H_2SO_4, 32% HNO_3 and 8% water by blending **[8]**

i) the spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O,

ii) aqueous 90% HNO_3, and

iii) aqueous 98% H_2SO_4,

All percentages are by mass. Calculate the quantities of each of the three acids required for blending.

SECTION - II

Q5) a) In manufacture of chlorine, feed containing hydrochloric acid and air are fed to oxidizer. The product gas leaving the oxidizer are found to contain 13.2% HCl, 6.3% O_2, 42.9% N_2, 30% Cl_2 and 7.6% H_2O (by weight). **[10]**

Calculate:-

i) Percent excess air used.

ii) Composition by weight of gases entering the oxidizer.

iii) Degree of completion of oxidation.

b) Calcium carbide is produced according to the reaction

$CaO + 3C \rightarrow CaC_2 + CO$

Estimate the requirement of lime and cock for production of 1000kg of calcium carbide with the composition of 78% CaC_2, 15% CaO, 3% C and 4% other impurities. **[6]**

Q6) a) A natural gas has following composition on mole basis: **[8]**

$CH_4 = 84\%$, $C_2H_6 = 13\%$ and $N_2 = 3\%$.

Calculate:

i) The heat added to heat 2 kmol of gas mixture from 311K (38°) to 533K (260°C).

ii) The heat to be added to heat 200 kg of natural gas from 311K (38°C) to 533 K(260°C).

Data : C^{o}_{pm} values in kJ/kmolK.

b) Tin is melted in an open pan using a jacket. The jacket is fed with the vapours of an eutectic mixture of diphenyl-diphenyl oxide at 171kPa.a. Tin is fed to the pan at 303K (30°C). Calculate the quantity of eutectic mixture of the diphenyl-diphenyl oxide condensed per 100 kg of tin melted at its melting temperature. Assume no subcooling of vapours. **[8]**

Data for Tin:

Molar mass, M = 118.7

Melting point = 505K

Latent heat of fusion, λ_f = 7201 kJ/kmol

Heat capacity of solid tin, C_{ms} = 21.14 + 0.02T kJ/(kmol. K).

Latent heat of Condensation of diphenyl-diphenyl oxide = 278 kJ/kg.

Q7) Calculate the heat of reaction at 773 K(500°C) for the following reaction: **[18]**

$$CO_{2(g)} + 4H_{2(g)} \rightarrow CH_{4(g)} + 2H_2O_{(g)}$$

$\Delta H^{O}_{R} = -165.1$ kJ/kmol.K

Heat capacity data:

$C^{o}_{p} = a + bT + cT^2 + dT^3$, kJ/kmol.K

Component	a	b × 10^3	c × 10^6	d × 10^9
CO_2	21.3655	64.2841	–41.0506	9.7999
H_2	28.6105	1.0194	1.0194	0.769
CH_4	19.2421	52.1135	11.973	–11.3173
H_2O	32.4921	0.0976	13.2107	–4.5474

Q8) a) Calculate the net calorific value (NCV) at 298 K (25°C) at a sample of a fuel oil having C/H ratio 9.33 (by weight) and containing sulphur to the extent of 1.3% by weight.

Data: the GCV of the fuel oil at 298K (25°C) = 41785kJ/kg

Latent heat of vapour at 298K (25°C) = 2442.5kJ/kg. **[7]**

b) Write Short notes on: **[9]**

i) Degree of Freedom.

ii) Concept of Recycle.

iii) Orsat & Ultimate Analysis.

S-516

Total No. of Pages : 3

Seat No.	

S.E. (Chemical) II Examination, May-2015
PROCESS CALCULATIONS
Sub. Code : 43658

Day and Date : Saturday, 09-05-2015 **Total Marks : 100**
Time : 10.00 a.m. to 1.00 p.m.

Instructions : **1)** **Assume suitable data, if necessary.**
2) **Answer any three questions from each section.**

SECTION-I

Q1) a) A force equal to 19.635 kgf is applied on a piston with diameter of 5 cm. Find the pressure exerted on piston in kPa, bar and Psi. **[8]**

b) The volumetric flow rate of kerosene in an 80mm diameter pipe is 75 Imp. gallons per minute, density of kerosene is 0.8 kg/dm^3. Find the mass flow rate in kg/s. **[8]**

Q2) a) A solution of caustic soda in water contains 20% NaOH (by wt). The density of solution is 1.196 kg/l. Find molarity, molality and normality. **[9]**

b) A sample of water contains 35000 ppm solids. Express the concentration of solids as % wt. **[8]**

Q3) a) Calculate the available nitrogen in the following: **[8]**

i) Commercial ammonium sulphate (96 % pure).

ii) Pure sodium nitrate (100 %).

b) The analysis of gas sample is given below on volume basis. **[8]**

Methane 68 %, CO_2 30%, NH_3 = 2 % and H_2S, SO_2 - Traces.

Find:

i) Avg. Mol. wt (Mavg)

ii) density of gas mixture at NTP.

P.T.O.

Q4) a) An aqueous solution of soda ash contains 20% (by wt) soda ash. Express the composition as % wt Na_2O. **[8]**

b) State: **[9]**

i) Amagat's law.

ii) Dalton's law.

iii) Raoult's law.

SECTION-II

Q5) a) It is required to make 1000 kg mixed acid containing 60% H_2SO_4, 32% HNO_3 and 8% H_2O by blending **[8]**

i) Spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O,

ii) aq. 90% HNO_3 and

iii) aq. 98% H_2SO_4 by wt. Calculate the quantities of each of three acids required.

b) An evaporator is fed continuously with 50000 kg/hr of a solution containing 10% NaOH, 10% NaCl and 80% H_2O by weight. During evaporation, water is removed and NaCl precipitates as crystal. The concentrated liquor leaving the evaporator contains 50% NaOH, 2% NaCl and 48% water. **[9]**

Calculate:

i) kg of H_2O evaporated/hr

ii) kg of salt precipitated/hr

iii) kg of concentrated liquor produced/hr

Q6) a) CCl_4 is produced as follows **[8]**

$$CS_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$$

The product gases are found to contain

	CCl_4	S_2Cl_2	CS_2	Cl_2
% mole	23.3	23.3	1.4	32.0

Calculate:

i) % excess reactant.

ii) % conversion.

b) Calculate the following for the reaction. [9]

$C_2H_4 + 2Cl_2 \rightarrow C_2HCl_3 + H_2 + HCl$

i) Stoichiometric ratio of Cl_2 to C_2H_6

ii) If 4 kg mole Cl_2 are used/kgmole C_2H_4, find % excess Cl_2

iii) kg of HCl produced from 50 kg of C_2H_4

Q7) a) A stream of CO_2 flowing at a rate of 100 g mole/min is heated from 25°C to 110°C. Calculate the heat that must be transfered using Cp° data. [8]

Data-

$Cp° = a + bT + cT^2$ cal/gmol K

Gas	a	$b \times 10^3$	$c \times 10^6$
CO_2	6.339	10.14	–3.415

b) Calculate the heat of formation of ethane gas from its elements using Hess's law. [8]

Data-

i) $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -94051$ cal.

ii) $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$ $\Delta H_2 = -68317$ cal.

iii) $C_2H_6(g) + 3.5\ O_2(g) \rightarrow 2\ CO_2(g) + 3H_2O(l)$ $\Delta H_c^o = -372820$

Q8) a) A coke is known to contain 90% carbon and 10% non combustible ash (by wt)

i) How many gmole of O_2 are theor. required to burn 100kg coke completely.

ii) If 50% excess air is supplied, calculate the analysis of gases at the end of combustion. [10]

b) Explain the degree of freedom. [6]

●●●●●

S-2186

Total No. of Pages : 3

Seat No.	

S.E. (Chem) -II,Examination, December-2015
PROCESS CALCULATIONS
Sub. Code : 43658

Day and Date : Wednesday, 2-12-2015 **Total Marks : 100**
Time :10.00 a.m. to 1.00 p.m.

Instructions : 1) **Answer any three questions from each section.**
2) **Assume suitable data if necessary.**

SECTION-I

Q1) a) Convert 0.2 atm.g into absolute pressure in mm Hg, bar, N/m^2, kgF/cm^2. **[8]**

b) How many kg mole of H_2SO_4 Nill contain 64 kg 's'? **[8]**

Q2) a) Calculate the number of cubic meters of H_2S measured at a temp of 50°C and pressure of 755 mm Hg; which may be produced from 3.5kg of iron sulfide. **[8]**

Data: At. wt. of Fe = 55.85 &S=32

b) A gas mixture contains 0.274 kg mole of HCl, 0.337 g mole N_2 and 0.089kg mole 0 2. Calculate the partial pressure of each component at 2280mmHg and at 30°C. **[8]**

Q3) a) By Electrolyting a mixing brine, a mixture of gases obtained at cathode having composition.

Cl_2 = 67%, Br_2 = 28% and O_2 = 5%

Calculate the density of gas mixture in g/ liter at 25°C and 740 mmHg.

Data: At. wt. for Cl = 35.5, Br = 80 O =16 **[12]**

b) A gas mixture contains 50% wt H_2 and 50% wt. N_2 at 10 atm and 30°C. Find density of gas mix in kg/m^3.

[6]

P.T.O.

Q4) a) A spent acid has the following composition by wt.
H_2SO_4=20%, NH_4HSO_4= 45% H_2O=30% and organic compounds = 5% .Calculate the total acid content of the spent acid in terms of H_2SO_4,after adding the acid content, chemically bound NH_4HSO_4. **[8]**

b) Tray dryer is fed with 1000kg of wet O-nitro-aniline containing 10% water.The dried product contains 99.5% O-nitro-aniline and rest H_2O. Find % of original H_2O removed in dryer. **[8]**

SECTION-II

Q5) a) A liquid stream containing 1000 PPM solids is fed to a treatment plant where solids are separated to get liquid product containing 50PPM solids and a waste liquid stream containing 20000 PPM solids. Based on 10000kg/h of liquid stream, calculate the flow rate of product stream. **[8]**

b) Fresh juice contains 15% solids and 85% H_2O by weight and to be concentrated to contain 40% solids by wt.In a single evaporation system, it is found that volatile constituents of juice escape with water leaving the concentrated juice with flate taste. To overcome this problem, a part of fresh juice by passes the evaporator. The juice stream leaving evaporator contains 55% solids. draw a neat diagram and calculate.

i) Fraction of fresh juice that bypass evaporator

ii) The concentrated juice produced per 100 kg fresh juice fed to process. **[10]**

Q6) a) In a production of SO_3 100 kg mole SO_2 and 200kg mole of O_2 are fed to reactor. The product stream is found to contain 80 kg mole SO_3. Find % conversion of SO_3 **[8]**

b) SO_2 is oxidised to SO_3. If conversion is 70% and air is used in excess 80% over theoretical requirement calculate.

i) The kg mole air feel per kg mole SO_2

ii) Composition of gases leaving reactor on (volume basis). **[8]**

Q7) a) A stream flowing at a rate of 250 g mole/ min contains 25% by mole N_2 and 75% by mole H_2 is to be heated from 25°C to 200°C, calculate the heat must be transferred.

Data $Cp^{\circ} = a+bT+cT^2$

Gas	a	$b\times10^3$	$c\times10^6$
H_2	6.946	-0.196	0.4757
N_2	6.457	+1.389	-0.069

[8]

b) Calculate the standard heat of reaction of the following reaction.

$(COOH)_2$ (s) $\rightarrow$ H COOH(l) + CO_2(g)

Data: Heat of combustion

Component	$(COOH)_2$(s)	H COOH (l)
$\Delta H^{\circ}C$	-58.82	-64.57

[8]

Q8) a) A gas stream containing 65% mole ethane and 35% butane is fed to combustion chamber where it is oxidised to CO_2 and H_2O.Air is supplied 20% Excess of that their required. Calculate the amount of gas leaving the chamber per 100 kg of gas feed. **[8]**

b) Oxidation of ethylene to produce ethylene oxide is given by reaction. **[8]**

$$C_2H_4 + \tfrac{1}{2} O_2 \rightarrow C_2H_4O.$$

If air is used 20% in excess of that theoretically required.

Calculate the quantity of air supplied based on 100 kg mole of ethylene fed to reactor.

S-2190

Total No. of Pages : 4

Seat No.	

S.E. (Chemical Engg.) (Part-II) (Semester-II) (New Course) Examination, December-2015

PROCESS CALCULATION

Sub. Code : 63429

Day and Date:Tuesday, 01-12-2015
Time : 10.00 a.m. to 01.00 p.m. **Total Marks : 100**

Instructions : 1) **Assume suitable data, if necessary.**
2) **Answer any three questions from each section.**

SECTION-I

Q1) a) A force equal to 192.6 kgf is applied on a piston with a diameter of 5cm. Find the pressure exerted on the piston in kPa, bar and psi, mmHg. **[8]**

b) A Sample of Caustic soda flakes contains 74.6 % Na_2O by weight. Determine the purity of the flakes. **[8]**

Q2) a) 1000 m^3 of a mixture of H_2, N_2 & CO_2 at 150°C was found to have the following ratio of the partial pressure of the gases : $P_{H_2} : P_{N_2} : P_{co_2} = 1:4:3$. If total pressure = 2 atm abs; find **[12]**

i) Mole fr. of each of these gases.

ii) Wt fr. of these gases.

iii) Avg. mol wt of gas mixture.

iv) Wt of CO_2 in kg.

b) State and explain the Raoult's law. **[6]**

Q3) a) A spent acid from fertilizer has the following composition by wt. H_2SO_4 = 20%, NH_4HSO_4 = 45% , H_2O = 30% & organic compounds = 5% Calculate the total acid content of spent acid in terms of H_2SO_4 after adding the acid content, chemically bound ammonium hydrogen sulphate . **[8]**

b) In a textile mill, a double effect evaporator system concentrate weak liquor containing 4% by mass caustic soda to produce lye containing 25% solids (by mass). Calculate the evaporation of H_2O per 100 kg of feed in the evaporator. **[8]**

Q4) a) Soyabean seeds are extracted with hexane in batch extractors. The flaked seeds are found to contain 18.6% oil, 69.6% solid and 12.4% moisture (by weight) . At the end of extraction process, cake (meal) is separated from hexane oil mixture. The cake is analyzed to contain 0.8% oil, 87.7% solid and 11.5% moisture (by weight) . Find the percentage recovery of oil. **[8]**

b) Find purification stage in the preparation of certain pharmaceutical product 'A' from natural sources requires centrifuging & filtration as shown in fig.1. Determine the flowrate of recycle stream, kg/h. **[8]**

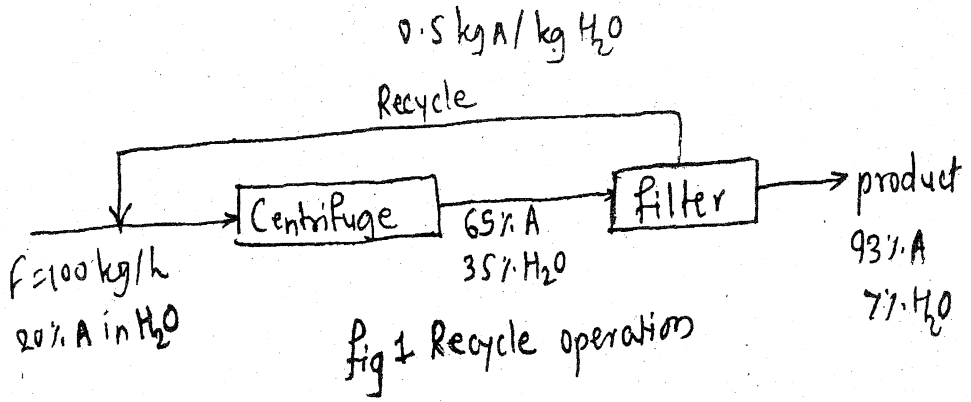


fig 1 Recycle operation

SECTION-II

Q5) Formaldehyde is produced by dehydrogenation of methanol.

$$CH_3OH \rightarrow HCHO + H_2$$

The per pass conversion is 67% . The product leaving the reactor is fed to separation unit battery where formaldehyde is separated from methanol and hydrogen. The separated methanol is recycled to reactor. If the production rate of formaldehyde is 1000 kg/h, calculate; (a) combined feed ratio and (b) flow rate of methanol required to the process as fresh feed. **[16]**

Q6) a) A stream flowing at rate of 15000 mol/h containing 25 mole % N_2 and 75 mole % H_2 is to be heated from 298K (25°C) to 473K (200°C). Calculate the heat that must be transferred using C_p° data given below: $C_p^\circ = a + bT + cT^2 + dT^3$, kJ / (kmol.K). **[8]**

Gas	a	b × 10^3	c × 10^6	d × 10^9
H_2	29.5909	-5.41	13.1829	-4.968
N_2	28.6105	1.0194	-0.1476	0.769

b) Calculate the standard heat of formation of chloroform gas from its element using Hess's law. Data: **[8]**

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H_1 = -393.51 \text{ kJ / mol}$$

$$H_2(g) + \frac{1}{2}O_2 \rightarrow H_2O \qquad \Delta H_2 = -285.83 \text{ kJ / mol}$$

$$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(aq) \qquad \Delta H_3 = -167.57 \text{ kJ / mol}$$

$$CHCl_3 + \frac{1}{2}O(g) + H_2O \rightarrow CO_2(g) + 3HCl(aq) \qquad \Delta H_c^\circ = -509.95 \text{ kJ / mol}$$

Q7) a) Calculate GHV and NHV at 298K (25°C) of the gas having following composition by volume CH_4 = 74.4%, C_2H_6 = 8.4 %, C_3H_8 =7.4%, i - C_4H_{10} =1.7%, n- C_4H_{10} =2.0%, i- C_2H_{12} = 0.5%, n- C_2H_{12} =0.7%, N_2 = 4.3%, & CO_2 = 0.9%.

Data:

Component	GCV, KJ/ mol	NCV, KJ/ mol
CH_4	890.65	802.62
C_2H_6	1560.69	1428.64
C_3H_8	2219.17	2043.11
i-C_4H_{10}	2868.20	2648.12
n- C_4H_{10}	2877.40	2657.32
i- C_5H_{12}	3528.83	3264.73
n- C_5H_{12}	3535.77	3271.37

Sp.Volume of gas = 298K (25°C) & 101.3 kPa =24.465 m^3/kmol. **[10]**

b) The Orsat analysis of the flue gases from a boiler house chimney gives CO_2 : 11.4%, O_2: 4.2 %, and N_2: 84.4% (mole %). Assuming that complete combustion has taken place,

i) Calculate the % excess air , and

ii) Find the C:H ratio in the fuel. **[8]**

Q8) a) 100kg/h of methanol liquid at a temperature of 303K(30°C) is to obtained by Removing heat from saturated methanol vapour. Find out the amount of heat to be removed in this case.
Data: Boiling point of methanol=337.8 (64.8°C)
Latent heat of condensation of methanol =1101.7 kJ / kg
Specific heat of methanol = 2.7235kJ / (kg.K) **[7]**

b) Write short note on: **[9]**

i) Percentage Conversion , Percent Excess, Yield & Selectivity.

ii) Enthalpy change during phase change operation.

iii) Recycle Ratio.

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W – 729

Total No. of Pages : 4

Seat No.	

S.E. (Chemical Engg.) (Part -II) (Semester - IV) Examination, May - 2014

PROCESS CALCULATIONS

Sub. Code : 43658

Day and Date : Tuesday, 20 - 05 - 2014 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) Attempt any three questions from each section.
2) Assume suitable data if necessary.

SECTION - I

Q1) a) The diameter and height of a vertical cylindrical tank are 5 ft and 6 ft 6 inch respectively. It is full upto 75% height with CCl_4, the density of which is 1.6 kg/L. Find the mass in kg. [8]

b) A compound whose mole weight is 10.3, analyzes as following (% wt basis)
C : 81.5%, H: 4.9 N: 13.6
What is formula? [8]

Q2) a) Calculate the available nitrogen in the following : [4 + 4 = 8]
i) Commercial ammonium sulphate (96% pure)
ii) Pure sodium nitrate (100%)

b) An aqueous solution of K_2CO_3 is prepared by dissolving 43 kg K_2CO_3 in 100 kg water. The density of the solution is measured to be 1.3 kg/l. Find the molarity, normality and molality of solution. [9]
Data : Atomic weight K = 39.9

Q3) a) Bottled liquid gas of the following composition [8]

Component :	n butane	Propane	Ethane
% mole :	50	45	5
Vapor pr. at : 30°C	3.4	10.8	46.6

Determine the pressure of the system and equlibrium vapor composition at 30°C.

P.T.O.

b) A natural gas having the composition, CH_4: 94.10, C_2H_6: 3% and N_2: 3% is piped from the well at 25°C and 3.0 atm pressure. Find out : **[8]**

i) P.P. of N_2 ii) Volume of N_2/100 cu.m of gas

iii) Density of the gas

Q4) a) Stock containing 1.562 gram of water/gram of dry stock is to be dried to 0.099 gram. For each gram of stock (dry basis) 52.5 gram of dry air pass through the drier, leaving at a humidity of 0.0525. The fresh air is supplied at a humidity 0.0152. Calculate the friction of air recirculated. The process is shown in fig.1 **[9]**

Note : The humidity values are taken as $\frac{\text{gram } H_2O}{\text{gram dry air}}$

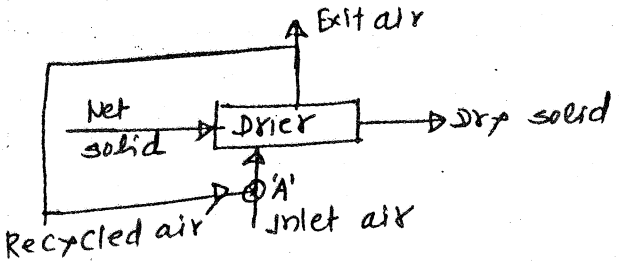

fig ① A drier

b) In a textile Mill, a double effect Evaporator system concentrates weak liquor containing 4% by wt. Caustic soda to produce a lye containing 25% solids by wt. Calculate the evaporation of water per 100 kg feed in the evaporator. **[8]**

SECTION - II

Q5) a) In a Deccan process for the manufacture of chlorine, a dry mixture HCl gas and air is passed over a heated catalyst which promotes oxidation of the acid. Air is used in 30% excess of the theor. required. **[8]**

Calculate :

i) The weight of air supplied per kg acid.

ii) The composition by weight of the gas entering the reaction chamber.

b) A phosphat sock, chiefly a mixture of $Ca_3(PO_4)_2$ and inerts contains 32% P_2O_5 and is treated with 95% H_2SO_4 to produce H_3PO_4.

1.2 tonne of rock is treated with 752 kg of the 95% H_2SO_4. The degree of completion of the reaction is 90% (based on $Ca_3(PO_4)_2$). **[8]**

Data :- Mol. Wt. of P_2O_5 = 142

Mole Wt. of $Ca_3(PO_4)_2$ = 310

Calculate Mole Wt. of $CaSO_4$ = 136

i) Weight and composition of H_3PO_4 produced.

ii) Weight and composition of solid residue.

Q6) a) Calculate the number of Kcal required to heat from 500K and 1500K, $1m^3$ (1 atm o_C) of a gas having the following composition. **[7]**

Gas	:	CO_2	N_2	O_2	H_2
% composition	:	70	27	2	1

The heat capacity equation :

$CP = a + bT + CT^2$, Kcal/K mole K

Where	a	$b \times 10^3$	$c \times 10^6$
CO_2	6.339	10.14	–3.415
N_2	6.457	1.389	–0.069
O_2	6.117	3.167	–1.005
H_2	6.946	–0.196	0.4757

b) Calculate the heat of reaction at 773K for the following reaction. **[9]**

$CO_2(g) + 4\ H_2(g) \rightarrow 2H_2O(g) + CH_4(g)$

Data : ΔH_F { $CO_2(g) = 393.65$ kj; $H_2O(g) = 241.9$ kj; $CH_4(g) = 74.89$ kj; $H_2(g) = 0$

Cp data

Gas	a	$b \times 10^3$	$c \times 10^6$
CO_2	26.54	42.25	–14.29
H_2	26.89	4.35	–0.3265
H_2O	29.18	14.50	–2.022
CH_4	13.41	77.08	–18.76

Q7) a) A producer gas with the composition by volume 27.3% CO 5.4%, CO_2, 0.6% O_2, 66.7% N_2 is burnt with 20% excess air. If the combustion is 98% complete, calculate the composition by volume of the fine gases. **[8]**

b) A furnace is fired with a natural gas that consists entirely of hydro carbons. The orsal-analysis of the fine gases gives 9.5% CO_2, 2% O_2 and 1.8% CO.

Calculate : [8]

i) The molar ratio of net hydrogen to carbon in the fuel.

ii) % excess air.

Q8) a) Explain the concept of degree of freedom. [6]

b) $6S_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$ [12]

Product gas composition is

Component	CCl_4	S_2Cl_2	CS_2	Cl_2
% mole	23.3	23.3	1.4	32.0

Calculate

i) % excess reactant

ii) % conversion

iii) $\frac{\text{kg } CCl_4 \text{ produced}}{100 \text{ Kg } Cl_2}$

W – 729

Total No. of Pages : 4

Seat No.	

S.E. (Chemical Engg.) (Part -II) (Semester - IV) Examination, May - 2014

PROCESS CALCULATIONS

Sub. Code : 43658

Day and Date : Tuesday, 20 - 05 - 2014 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) Attempt any three questions from each section.
2) Assume suitable data if necessary.

SECTION - I

Q1) a) The diameter and height of a vertical cylindrical tank are 5 ft and 6 ft 6 inch respectively. It is full upto 75% height with CCl_4, the density of which is 1.6 kg/L. Find the mass in kg. [8]

b) A compound whose mole weight is 10.3, analyzes as following (% wt basis)
C : 81.5%, H: 4.9 N: 13.6
What is formula? [8]

Q2) a) Calculate the available nitrogen in the following : [4 + 4 = 8]
i) Commercial ammonium sulphate (96% pure)
ii) Pure sodium nitrate (100%)

b) An aqueous solution of K_2CO_3 is prepared by dissolving 43 kg K_2CO_3 in 100 kg water. The density of the solution is measured to be 1.3 kg/l. Find the molarity, normality and molality of solution. [9]
Data : Atomic weight K = 39.9

Q3) a) Bottled liquid gas of the following composition [8]

Component :	n butane	Propane	Ethane
% mole :	50	45	5
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b) A natural gas having the composition, CH_4: 94.10, C_2H_6: 3% and N_2: 3% is piped from the well at 25°C and 3.0 atm pressure. Find out : **[8]**

i) P.P. of N_2 ii) Volume of N_2/100 cu.m of gas

iii) Density of the gas

Q4) a) Stock containing 1.562 gram of water/gram of dry stock is to be dried to 0.099 gram. For each gram of stock (dry basis) 52.5 gram of dry air pass through the drier, leaving at a humidity of 0.0525. The fresh air is supplied at a humidity 0.0152. Calculate the friction of air recirculated. The process is shown in fig.1 **[9]**

Note : The humidity values are taken as $\frac{\text{gram } H_2O}{\text{gram dry air}}$

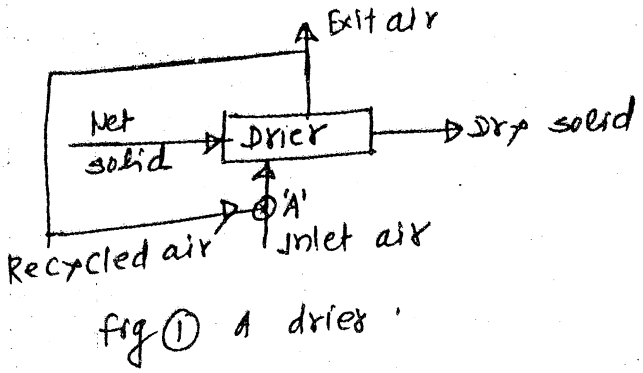

fig ① A drier

b) In a textile Mill, a double effect Evaporator system concentrates weak liquor containing 4% by wt. Caustic soda to produce a lye containing 25% solids by wt. Calculate the evaporation of water per 100 kg feed in the evaporator. **[8]**

SECTION - II

Q5) a) In a Deccan process for the manufacture of chlorine, a dry mixture HCl gas and air is passed over a heated catalyst which promotes oxidation of the acid. Air is used in 30% excess of the theor. required. **[8]**

Calculate :

i) The weight of air supplied per kg acid.

ii) The composition by weight of the gas entering the reaction chamber.

b) A phosphat sock, chiefly a mixture of $Ca_3(PO_4)_2$ and inerts contains 32% P_2O_5 and is treated with 95% H_2SO_4 to produce H_3PO_4.

1.2 tonne of rock is treated with 752 kg of the 95% H_2SO_4. The degree of completion of the reaction is 90% (based on $Ca_3(PO_4)_2$). [8]

Data :- Mol. Wt. of P_2O_5 = 142

Mole Wt. of $Ca_3(PO_4)_2$ = 310

Calculate Mole Wt. of $CaSO_4$ = 136

i) Weight and composition of H_3PO_4 produced.

ii) Weight and composition of solid residue.

Q6) a) Calculate the number of Kcal required to heat from 500K and 1500K, $1m^3$ (1 atm o_C) of a gas having the following composition. [7]

Gas	:	CO_2	N_2	O_2	H_2
% composition	:	70	27	2	1

The heat capacity equation :

$CP = a + bT + CT^2$, Kcal/K mole K

Where	a	$b \times 10^3$	$c \times 10^6$
CO_2	6.339	10.14	–3.415
N_2	6.457	1.389	–0.069
O_2	6.117	3.167	–1.005
H_2	6.946	–0.196	0.4757

b) Calculate the heat of reaction at 773K for the following reaction. [9]

$CO_2(g) + 4\ H_2(g) \rightarrow 2H_2O(g) + CH_4(g)$

Data : ΔH_F { $CO_2(g) = 393.65$ kj; $H_2O(g) = 241.9$ kj; $CH_4(g) = 74.89$ kj; $H_2(g) = 0$

Cp data

Gas	a	$b \times 10^3$	$c \times 10^6$
CO_2	26.54	42.25	–14.29
H_2	26.89	4.35	–0.3265
H_2O	29.18	14.50	–2.022
CH_4	13.41	77.08	–18.76

Q7) a) A producer gas with the composition by volume 27.3% CO 5.4%, CO_2, 0.6% O_2, 66.7% N_2 is burnt with 20% excess air. If the combustion is 98% complete, calculate the composition by volume of the fine gases. [8]

b) A furnace is fired with a natural gas that consists entirely of hydro carbons. The orsal-analysis of the fine gases gives 9.5% CO_2, 2% O_2 and 1.8% CO.

Calculate : [8]

i) The molar ratio of net hydrogen to carbon in the fuel.

ii) % excess air.

Q8) a) Explain the concept of degree of freedom. [6]

b) $6S_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$ [12]

Product gas composition is

Component	CCl_4	S_2Cl_2	CS_2	Cl_2
% mole	23.3	23.3	1.4	32.0

Calculate

i) % excess reactant

ii) % conversion

iii) $\frac{\text{kg } CCl_4 \text{ produced}}{100 \text{ Kg } Cl_2}$

Seat No.	

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Total No. of Pages : 4

S.E. (Chemical Engg.) (Semester - II) Examination, April - 2016

PROCESS CALCULATIONS (New)

Sub. Code : 63429

Day and Date : Friday, 22 - 04 - 2016 **Total Marks : 100**

Time : 10.30 a.m. to 01.30 p.m.

Instructions : 1) **Attempt any three questions from each section.**

2) **Assume suitable data if necessary.**

SECTION - I

Q1) a) A force equal to 19.635 kgf is applied on a piston with a diameter of 5 cm. Find the pressure exerted on the piston in kPa, bar and psi. **[8]**

b) An aqueous solution contains 20.0% $(NH_4)_2SO_4$, 20% NH_4NO_3 and 30% Urea (NH_2CONH_2) (by mass). Calculate the available nitrogen in solution. **[9]**

Q2) a) The strength of a Phosphoric acid (H_3PO_4) sample is found to be 35% P_2O_5 by weight. Determine the actual concentration of H_3PO_4 (by Weight) in the acid. (Atomic Weights: H = 1, C = 12, N = 14, O = 16, P = 31). **[8]**

b) In the Monsanto process for the manufacture of formaldehyde, air (N_2&O_2), methanol and steam are mixed in the proportion 4:2:1.33 (by mass) at 100°C (373.15 K). The total pressure is 68.6 kpa.g. Calculate the partial pressure of each of the component present in the mixture. **[9]**

Q3) a) The analysis of a sewage gas sample from a municipal sewage treatment plant is given below on a volume basis: **[8]**

CH_4 (Methane) - 68%

CO_2 (Carbon Dioxide) - 30%

NH_3 (Ammonia) - 2%, H_2S, SO_2 etc traces

Find : i) The average molar mass of the gas.

ii) The density of the gas at NTP.

P.T.O.

b) The liquid mixture contains n-butane 1-butane and furfural. It is boiled a 338K and 570.46 kPa.g pressure. The mole fraction of n-butane in th ternary vapor mixture in equilibrium with liquid is found to be 49.1% b volume. Assuming ideal behavior of liquid and vapor mixtures. Find th composition of vapor mixtures. [8]

Data: Vapor pressure of furfural = 3.293 kPa at 338K.

Mole fraction of furfural in liquid mixtures = 0.7734.

Q4) a) An evaporator is fed continuously with 50000 kg/hr of a solution containing 10% NaOH, 10% NaCl and 80% water by weight. During the evaporation, water is boiled off and NaCl precipitates as crystals and removed from the remaining liquor. The concentrated liquor leav 3 the evaporator contains 50% NaOH, 2% NaCl and 48% water. Calculate **[8]**

i) kg of water evaporated per hour

ii) kg of salt precipitated per hour

iii) kg of concentrated liquor produced per hour

b) A production of 5000 kg mixed acid containing 55% H_2SO_4, 35% HNO_3 and 10% water by blending **[8]**

i) The spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O

ii) Aqueous 88% HNO_3 and

iii) Aqueous 97% H_2SO_4. All percentages are by weight

Calculate quantities of each of the three acids required for blending.

SECTION - II

Q5) a) In the Decon process for the manufacturing of Chlorine gas by oxidation of Hydrochloric acid gas, air is used 30% excess of that theoretically required. $4HCl + O_2 \rightarrow 2Cl_2 + 2H_2O$. Based on 4 kmol HCl, calculate:**[8]**

i) Weight ratio of air to HCl gas in feed.

ii) If oxidation is 80% complete, find the composition of product stream on mole basis.

b) Tin is melted in an open pan using a jacket. The jacket is fed with the vapours of an eutectic mixture of diphenyl-diphenyl oxide at 171 kPa.a. Tin is fed to the pan at 303K (30°C). Calculate the quantity of eutectic mixture of the diphenyl-diphenyl oxide condensed per 100 kg of tin melted at its melting temperature. Assume no subcooling of vapours. **[8]**

Data for Tin :

Molar mass, M = 118.7

Melting point = 505 K

Latent heat of fusion, λ_f = 7201 kJ/kmol

Heat capacity of solid tin, C_{ms} = 21.14 + 0.02T kJ/(kmol.K)

Latent heat of condensation of diphenyl-diphenyl oxide vapours, λ_v = 278 kJ/kg.

Q6) a) In the production of sulphuric acid from anhydrite, the gypsum is roasted with clay to obtain sulphur dioxide & cement clinker. The reaction proceeds as follows: **[8]**

$$3CaSO_4(s) + SiO_2(s) \rightarrow 3\ CaOSiO_2(g) + 3SO_2(g) + 3/2\ O_2(g)$$

Calculate the heat of reaction at 298.15K Data:

Component	$CaSO_4$	SiO_2	3 $CaO.SiO_2$	SO_2	O_2
ΔH_f at 298.15K, KJ/kmol	- 1432.7	- 903.5	- 2879.0	- 296.81	0.0

b) Calculate the standard heat of formation of n-heptane at 298.15K using the following data: **[8]**

Standard heat of formation of CO_2 (g) = - 393.51 kJ/mol

Standard heat of formation of H_2O (1) = - 285.83 kJ/mol

Standard heat of combustion of C_7H_{16}(g) = - 4853.43 kJ/mol

Q7) Obtain an expression relating the heat of reaction and the temperature of the reaction.

$$SO_2(g) + ½\ O_2(g) = SO_3(g).$$

Using the same expression, calculate the heat of reaction at 775 K (502°C). **[18]**

Data: $C_p^\circ = a + bT + cT^2 + dT^3$, kJ/kmol.K)

Component	a	b × 10^3	c × 10^6	d × 10^9
SO_3	22.036	121.624	- 91.867	24.369
SO_2	24.771	62.948	- 44.258	11.122
O_2	26.026	11.755	- 2.343	- 0.562

Component	ΔH_f°, kJ/ kmol
SO_3 (g)	- 395720
SO_2 (g)	- 296810

Q8) a) Crude oil found to contain 87.1% Carbon, 12.5% Hydrogen and 0.4% Sulphur (by mass). Its GCV at 298.15 K is measured to be 45071 KJ/Kg oil. Calculate its NCV at 298.15 K. **[8]**

b) Calculate GHV and NHV at 298 K (25°C) of the gas in kJ/kmol, kJ/kg having following composition by volume CH_4 = 89.4%, C_2H_6 = 5.0%, C_3H_8 = 1.9%, i-C_4H_{10} = 0.4%, n - C_4H_{10} = 0.6%, N_2 = 2.0% & CO_2 = 0.7%. **[8]**

Data:

Component	GCV, KJ/mol	NCV, KJ/mol
CH_4	890.65	802.62
C_2H_6	1560.69	1428.64
C_3H_8	2219.17	2043.11
i-C_4H_{10}	2868.20	2648.12
n-C_4H_{10}	2877.40	2657.32

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Total No. of Pages : 4

Seat No.	

S.E. (Chemical) (Part - II) (Semester - IV) (Revised) Examination, April - 2017

PROCESS CALCULATIONS

Sub. Code : 63429

Day and Date : Saturday, 29 - 04 - 2017 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) **Answer any three questions from each section.**
2) **Assume suitable data, if necessary.**

SECTION - I

Q1) a) Small animals such a mice can live at reduced air pressure down to 20 kPa. In a test, a mecury manometer attached to tank reads 64.5 cm Hg and barometer reads 100 kPa will the mice survive? **[8]**

b) A sample of sea water contains 35000 PPM solids. Express the concentration of solids as % weight. **[8]**

Q2) a) A sample of aq. triethanol amine (TEA) solution contains 47 % TEA (on volume basis). If density of pure TEA is 1125 kg/m^3. Find % weight of TEA in selection. **[9]**

b) The analysis of sample of glass yields is as follows: **[8]**

Component	Na_2O	MgO	ZnO	Al_2O_3	B_2O_3	SiO_2
% wt	7.8	7.0	9.7	2.0	8.5	65.0

Convert this composition in % mol

Data:-	Atom	Na	Mg	Zn	Al	B	Si	O
	Atomic weight	23.0	24.3	65.39	26.98	10.8	28	16

P.T.O.

Q3) a) A flue gas analyzes 14.0% CO_2, 6.0% O_2 and 80.0% N_2. It is having 765.0 mm Hg pressure. Calculate the partial pressure of each component. The composition is in mole%. **[8]**

b) The liquid mixture of n-butane, 1 butane and furfural is boiled at 338 K and 0.57 MPa.g. The mole fr. of n-butane in the ternary vapor mix in equilibrium with the liquid in to be found to be 49.1% volume. Assuming ideal behaviour of liquid and vapor mixture, find composition of vapor mixture. **[9]**

Data:- V.P. of furfural at 338 K = 3.293 kPa

% mole of furfural in liquid mixture = 77.38

Q4) a) In a textile mill, a evaporater system concentrates weak liquor containing 4% by weight caustic soda to produce a lye containing 25% solids by weight. Calculate the evaporation of water per 100 kg feed in the evaporator. **[8]**

b) Soyabean seeds are extracted with hexane in batch extractors. The flaked seeds contain 18.6% oil, 69.0% solids and 12.4% Moisture. At the end of extractor process, deoiled cake is separated from hexane-oil mixture. The deoiled cake contains 0.8% oil, 87.7% solids, and 11.5% Moisture. Find % recovery of oil. All % are by weight. **[8]**

SECTION - II

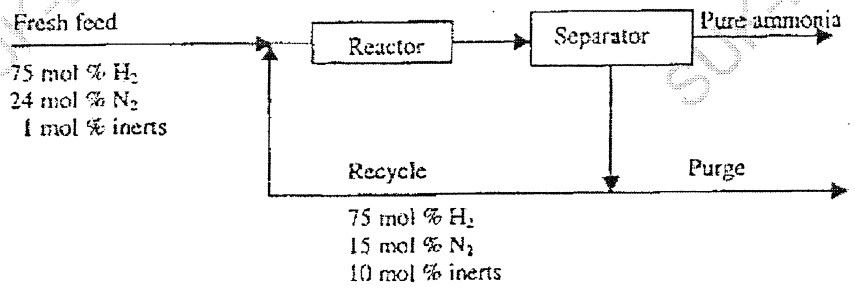
Q5) a) In the Decon process for the manufacturing of chlorine gas by oxidation of hydrochloric acid gas, air is used 30% excess of that theoretically required. $4HCl + O_2 \rightarrow 2Cl_2 + 2\ H_2O$

Based on 4 kmol HCl, calculate:

i) Weight ratio of air to HCl gas in feed.

ii) If oxidation is 80% complete, find the composition of product stream on mole basis. **[8]**

b) Ammonia is synthesized at 200 bar and 773 K by the reaction $N_2 + 3H_2 \leftrightarrow 2NH_3$. The yield of ammonia is 0.45 mol/mol of fresh feed. Flow sheet for the process (along with available compositions) is shown below.



The single pass conversion for H_2 in the reactor is 20%. Calculate amount of H_2 lost in the purge as a percentage of H_2 in fresh feed. **[8]**

Q6) A natural gas has the following composition on mole basis: **[18]**

CH_4 = 84%, C_2H_6 = 13%, and N_2 = 3%

Calculate the heat to be added to heat 10 kmol of natural gas 298 K(25°C) to 523K (250°C) using heat capacity data given below:

$C^0_p = a + bT + cT^2 + Dt^3$, kJ/(kmol.K)

Gas	a	b × 10^3	c × 10^6	d × 10^9
CH_4	19.2494	52.1135	11.973	-11.3173
C_2H_6	5.4129	178.0872	-67.3749	8.7147
N_2	29.5909	-5.141	13.1829	-4.968

Q7) a) Calculate the heat absorbed for isothermal reaction, **[8]**

$C_4H_{10(g)} \rightarrow C_2H_{4(g)} + C_2H_{6(g)}$; at 298 k and 1 atm pressure

Standard heat of combustion, kJ/mol: $C_4H_{10(g)}$ = -2573.5; $C_2H_{4(g)}$ = -1411.9, $C_2H_{6(g)}$ = -1561.0

b) Calculate the standard heat of formation of chloroform gas from its element using Hess's law. **[8]**

Data:

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta H_1 = -393.51$ kJ/mol

$H_2(g) + \frac{1}{2} O_2 \rightarrow H_2O$ $\quad \Delta H_2 = -285.83$ kJ/mol

$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(aq)$ $\quad \Delta H_3 = -167.57$ kJ/mol

$CHCl_3 + \frac{1}{2} O(g) + H_2O \rightarrow CO_2(g) + 3HCl(aq)$ $\quad \Delta H^o_C = -509.95$ kJ/mol

Q8) a) A furnace is fired with fuel oil. The orsat analysis of the fuel gases (by volume) is as given below: CO_2: 10.6%, O_2:6% and N_2 : 83.4%

Calculate the percentage excess air and find the C : H ratio in the fuel oil, assuming that fuel does not contain nitrogen. **[8]**

b) The products of combustion of methane in atmospheric air have the following composition on a dry basis: **[8]**

Products	CO_2	O_2	CO	N_2
Mole%	10.00	2.37	0.53	87.10

Calculate ratio of the moles of CH_4 to the moles of O_2 in the feed stream.

X X X