Code No: 07A70809 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,NOVEMBER 2010
CHEMICAL ENGINEERING MATHEMATICS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Solve the system of equations by SOR method
$$\begin{bmatrix} 4 & 0 & 2 \\ 0 & 5 & 2 \\ 5 & 4 & 10 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 4 \\ -3 \\ 2 \end{bmatrix}$$ [16]

2. The following heat transfer data is expected to follow a functional form of Nu = a $(Re)^b$ where Nu is Nusselt number and Re is Reynolds number. Obtain the best value for the constants 'a' and 'b' by the method of averages.

Re	12	20	30	40	100	300	400	1000	3000
Nu	2.0	2.5	3.0	3.3	5.3	10	11	17	30

[16]

3. Initially a tank contains 500 Kg of salt solution containing 10% salt. A stream containing 20% salt enters the tank at a flow rate of 10 Kg/h. The stream leaving the tank has a constant flow rate of 5 Kg/h. The tank is well stirred. Derive an equation relating the amount of the salt in the tank at any time t in hours. Solve the differential equation. [16]

4. (a) Solve $2x^2y\frac{d^2y}{dx^2} + y^2 = x^2\left(\frac{dy}{dx}\right)^2$
   (b) $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$ [8+8]

5. Solve the difference equation $Y_{n+2} - 4Y_{n+1} + 3Y_n = 5^n$ [16]

6. Describe the application of finite difference method, for the calculation of number of stages required for a counter - current liquid-liquid extraction system. [16]

7. In an experimental study of the safonification of ethyl acetate by sodium hydroxide, it is found that 30% of the ester is converted to alcohol in 15min when the initial concentrations of both ester and caustic are 0.02m. what conversion of ester would be obtained in one hour if the initial ester concentration were 0.030m and the initial caustic concentration 0.02m. [16]

8. Write on factorial and fractional factorial methods of designing of experiments. [16]

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Code No: 07A70809 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,NOVEMBER 2010
CHEMICAL ENGINEERING MATHEMATICS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) If Z=f (x, y) and x=r cos π, y =r sin π,prove that
$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$
   (b) If $T = (x^2 + y^2 + z^2)^{-1/2}$ show that $\nabla^2 T = 0$ [8+8]

2. (a) Explain about the classes of second order differential equations.
   (b) Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 4x + 8x^3$ [8+8]

3. (a) Write about the formulation of differential equation of physical problem.
   (b) Discuss a flow process in which a precipitation is being carried out by mixing two streams A and B to form a third stream C in which the precipitate is carried away. [8+8]

4. Use the method of averages to fit the best equation of the type Nu = a Pr^n to the following data.

Pr	0.74	4.2	5.6	3.0	5.0	10.0	17.7	18.6
Nu	30.0	60.3	69.0	58.4	70.7	84.5	115	115

[16]

5. Explain about the design of experiments. [16]

6. Solve the difference equation
$Y_{k+2} - 2Y_{k+1} + y_k = 2^k \quad with \quad Y_0 = 2 \;\; and \;\; Y_1(0) = 1.$ [16]

7. Write short notes on:
   (a) Calculation of number of plates required for an absorption column by finite difference method.
   (b) Non-linear finite difference equations - Analytical solutions. [16]

8. A process unit is fed with three liquid streams A, B, and C which separate out into two layers D and E. The compositions of the five streams in weight percent are as follows:

Component	Steam				
	A	B	C	D	E
1	7	0	40	21	5
2	15	40	18	17	80
3	75	11	0	37	5
4	3	49	42	25	10

It is desired to find the quantities of raw materials A and C required and the quantity of products D and E produced per 1000 kg of B processed. Solve the problem using the Gauss Seidal method. [16]

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Code No: 07A70809 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,NOVEMBER 2010
CHEMICAL ENGINEERING MATHEMATICS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. If Z= f(x, y) and if x=u-ν, y =uν, prove that
   (a) $(u+v)\frac{\partial z}{\partial x} = u\frac{\partial z}{\partial u} - v\frac{\partial z}{\partial v}$
   (b) $(u+v)\frac{\partial z}{\partial y} = \frac{\partial z}{\partial u} + \frac{\partial z}{\partial v}.v$ [8+8]

2. A boiling 100^0C solution s set on a table where room temperature s assumed to be constant at 20^0C The solution cooled to 60^0C after five minutes.
   (a) Find a formula for the temperature (T)of the soluton, t min after it placed on the table.
   (b) Determine how long time will take for the solution to cool to 22^0C. [8+8]

3. Calculate the least squares line and correlation coefficients for the following data:

X	89.16	84.16	74.79	86.47	82.87	57.77	79.07
Y	3.98	4.94	6.47	3.75	4.99	7.09	4.79

[16]

4. An ammonia gas is absorbed by a solution with which it reacts chemically. the rate of diffusion in the liquid will be assumed proportional to the concentration difference with in the distance, the diffusing gas is reacted by first order kinetics and the rate of reaction is proportional to the concentration in the liquid. derive an expression for the concentration in the liquid as a function of distance from the interface. [16]

5. A polymer blend is to be formed from three feed streams A, B and C having the following compositions in weight percent:

Component	Steam			
	A	B	C	Blend
1	25	35	55	30
2	35	20	40	30
3	40	45	5	40

Using Jacobi method determine the masses of A, B and C to produce 1000 kg of blend having the desired composition. [16]

6. Explain the factorial method of designing of experiments. [16]

7. A reactant A is to be converted into a product B in a battery of N continuous stirred tank reactors of total volume V m^3. If the feed rate is q m^3/min and the concentration of A is C_{A0}. Show that the production of B is a maximum when all the tanks are the same size. The rate of reaction can be taken to be first order and the battery is to operate isothermally. [16]

8. Solve the following difference equations:

   (a) $\mathrm{Y_{n+2}} - 2\mathrm{Y_n}\mathrm{Cos}\alpha + \mathrm{Y_{n-1}} = 0$.

   (b) $\mathrm{Y_{n+2}} - 5_{\mathrm{Yn+1}} - 6\mathrm{Y_n} = 2^{\mathrm{n}}$. [16]

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Code No: 07A70809 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,NOVEMBER 2010
CHEMICAL ENGINEERING MATHEMATICS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain about nonlinear and linear second order differential equations
   (b) Solve $1.5\frac{d^2y}{dx^2} - 3\frac{dy}{dx} = 9$ [8+8]

2. Describe about the forward differences, backward differences and make the forward difference and backward difference tables. [16]

3. Describe how finite difference method is applied for the calculation number of theoretical plates required for a distillation column. Illustrate with an example. [16]

4. Consider the rectangular fin. If the width of the fin is W and the thickness is 2B, (a) convert the governing equation interms of W and B (b) Introducing
   $V = \frac{T-T\infty}{Tw-T\infty} and\ Z = \frac{x}{L}$
   Where T_W = wall temperature ,L=Length of the fin
   $\frac{d^2V}{dZ^2} - M^2V = 0$
   Convert the differential equation into a dimensionless form: [16]

5. The table below gives the temperature T in ^{0}C and length L in mm of a heated rod. If L = a + bT, find the best values of 'a' and 'b' by using the method of averages.

T^0C	20	30	40	50	60	70
L (mm):	800.3	800.4	800.6	800.7	800.9	801.1

[16]

6. Analyse the following data obtained in a factorially designed experiment :

Run	Conc.%	Duration min.	Temp. ^0C	yield
1	87	15	60	6.08
2	93	15	60	6.04
3	87	30	60	6.53
4	93	30	60	6.43
5	87	15	70	6.79
6	93	15	70	6.68
7	87	30	70	6.73
8	93	30	70	6.18

[16]

7. A brass fin L m long is triangular in cross section. It is x m thick at the base and tapers off to a line. the base of this wedge shaped piece of metal is maintained at a constant temperature Tb, and the fin loses heat by the convection through the surrounding air which is at a temperature Ta, the surface coefficient of the heat transfer is h W/hr $m2^0$C. What is the relation between the temperature of the fin metal, T, and the distance from the base L-k? [16]

8. A settling tank is fed with three liquid streams F_1, F_2 and F_3 which separate out into two layers P_1 and P_2. The compositions of the five streams in weight percent are given below:

Component	Steam				
	F1	F2	F3	P1	P2
1	21	0	62	5	15
2	18	41	16	80	5
3	36	10	0	3	75
4	25	49	22	12	5

It is desired to find the quantities of raw materials F_2 and F_3 required and Products P_1 and P_2 produced per 1000 kg of F_1 processed. Solve the problem using Gauss-siedalmethod. [16]

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