Code No: M0830/R07 **Set No. 1**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011
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 tank contains 5 m^3 of fresh water, 0.2 m^3 of brine having a concentration of 15 g/m^3 of salt is run into the tank per minute and the mixture is kept uniform by mixing and runs out of the tank at the rate of 0.05 m^3 /min. What will be the exit brine concentration, when the tank contains 6 m^3 of brine? [16]

2. Solve the following differential equations
   a) $\frac{dy}{dx} - y \cot x = \cos ec\, x$ [8]
   b) $\frac{d^2y}{dx^2} - y = \tan x$ [8]

3. Derive the equation of continuity equation for a compressible fluid flowing through a cubical element for unsteady state conditions in rectangular co-ordinate system. [16]

4. Solve the following equation by using Gauss-Seidel iteration method.
   $x + 2y + z = 8$
   $2x - y + 2z = 6$
   $3x + 2y - z = 4$ [16]

5. Solve the finite difference equation
   $y_{n+2} + 2Ay_{n+1} + By_{n+1} = 0$
   Given that $y_0 = 0, y_1 = 3, y_2 = 6, y_3 = 36$ [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]

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7. a) Discuss about the propagation of errors through addition and subtraction. [6]
   b) Use the method of least squares to fit the straight line $y = a + bx$ to the following data [10]

x:	1	2	3	4	5
y:	5	8	11	14	17

8. Write on factorial method of designing of experiments. [16]

Set No. 2

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CHEMICAL ENGINEERING MATHEMATICS
(Chemical Engineering)

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1. Derive an equation for rate of heat flow through a composite wall constructed of a series of layers of different thermal conductivities, assuming the walls to be rectangular. [16]

2. Find the general solution of the differential equation

   $$\frac{dy}{dx} + 2y\tan x = 4\sin x$$

   If $y = 0$ *when* $x = \frac{\pi}{3}$, *show* that y has a maximum value of $\frac{1}{2}$ [16]

3. A semi –infinite solid maintained at an initial temperature T_0. The surface temperature at x=0 is suddenly increased and maintained at a temp. T_1. Derive the expression for the temperature distribution in the solid as a function of time and distance. [16]

4. Solve the following equations by Gauss-Seidel iteration method. [16]

   9 x - 2y + z = 50
   x + 5 y – 3z = 18
   -2 x + 2y + 7z = 19.

5. Solve the following second order linear finite difference equation with constant coefficients.

   $Y_{n+2} - A\,Y_{n+1} + B\,Y_n = \phi(n)$ [16]

6. Solve the following finite difference equations

   a) $y_{n+2}\,y_n = y_{n+1}^2$ [6]

   b) $x_{n+1}\,x_n + A\,x_{n+1} - Bx_n - C = 0$ [10]

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7. Use the method of average to find the best curve of the type. [16]

$$y = a\sin(x + B)$$

Which fits the following values A and B are constant.

x	0	30	60	90	120	150
y	0.944	1.242	1.208	0.850	0.264	-0.392

8. Analyse the following data obtained in a factorial designed experiment : [16]

Run	Temp.	Pressure	time	yield
1	100	20	10	2
2	200	20	10	4
3	100	60	10	8
4	200	60	10	6
5	100	20	30	10
6	200	20	30	8
7	100	60	30	12
8	200	60	30	18

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CHEMICAL ENGINEERING MATHEMATICS

(Chemical Engineering)

Time: 3 Hours **Max Marks: 80**

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1. Derive an expression for the temperature profile for the flow of heat from a rectangular fin. Clearly indicate the assumptions involved in the derivation. [16]

2. Solve the differential equation

$$x^3 \frac{d^2y}{dx^2} + x^2\left(\frac{dy}{dx}\right)^2 - y^2 = 0$$

with the help of the boundary conditions:

At x = 1, y = 2, $\frac{dy}{dx} = -1$ [16]

3. A slab (extending infinitely in the y and z directions) is at an initial temperature T_1. At time t = 0, the two faces are suddenly cooled at T_0. Derive an expression relating the temperature, time and position after quenching. [16]

4. Solve the following equations by Jacobi's iteration method. [16]

20 x + y – 2z = 17
3 x + 20 y –z = -18
2 x – 3y + 20z = 25

5. Find the thermal conductivity of propone at 100 atm. and 210^0F from the following data. [16]

$T\left({}^0F\right)$	P atm	$K\left(Btu/m.ft^2F\ ft^{-1}\right)$
154	96.7 131.5	0.0490 0.0518
189	88.9 131.8	0.0440 0.0466
222	96.7 140.9	0.0402 0.0435
284	95.3 123.0	0.0353 0.0376

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

7. Fit a function of the form $y = ax^b$ to the following other by using the method of least squares. [16]

x	2	4	7	10	20	40	60	80
y	43	25	18	13	8	5	3	2

8. Analyze the following data obtained in a factorially designed experiment. [16]

Run	Tem^{0}c	Time has	RPM	Yield
1	50	0.5	16	28
2	70	0.5	16	43
3	50	2.0	16	30
4	70	2.0	16	47
5	50	0.5	28	60
6	70	0.5	28	88
7	50	2.0	28	65
8	70	2.0	28	81

Code No: M0830/R07 **Set No. 4**

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CHEMICAL ENGINEERING MATHEMATICS
(Chemical Engineering)

Time: 3 Hours **Max Marks: 80**

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1. What is law of conservation of mass? Write down this to the example of salt accumulation in stirred tank. Develop the expression from fundamentals. Give the approximate nomenclature. Assumptions made if any, have to be clearly indicated [16]

2. Solve the differential equations
   a) $xy - \frac{dy}{dx} = y^4.\exp(-\frac{3x^2}{2})$ [8]
   b) $\frac{d^2y}{dx^2} + 2.\frac{dy}{dx} + 2y = e^{-x}.\cos x$ [8]

3. Heat is supplied at a fixed rate Q $\frac{Btu}{h\,ft^2}$ to one face of a large rectangular slab of density ρ lb/ft^3, specific heat C_p $\frac{Btu}{lb\,^0F}$ and thermal conductivity K $\frac{Btu}{h\,ft^2\,^0F\,ft^{-1}}$. Find the variation of surface temperature with time, during the early stage after exposure. [16]

4. Explain the Jacobi's and Gauss-Seidel iterative methods by considering an example. [16]

5. The thermal conductivities of methyl chloride at the temperature 50^0F, 100^0F, 200^0F, 250^0F, 300^0F and 400^0F is 0.0057, 0.0069, 0.0081, 0.0092, 0.0104, 0.0116, 0.127 and 0.0139. Estimate the thermal conductivity at 413^0F. [16]

6. Explain how finite difference method is applied for the calculation of the number of plates required for an absorption column. [16]

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Set No. 4

7. Find the values of a_0, a_1 *and* a_2, so that the parabola $y = a_0 + a_1 x + a_2 x^2$ fits the data by using the method of averages. [16]

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.2	1.5	2.6	2.8	3.3	4.1

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