B.E. CHEMICAL ENGINEERING EXAMINATION, 2018

(Second Year, 1st Semester)

NUMERICAL METHODS

Time: Three hours Full Marks: 100

Use a separate Answer-Script for each part

PART – I (50 marks)

Answer any FIVE questions

All question carry equal marks

1. Why pivoting is necessary to solve the system of linear equations? Solve the following system by Gauss Elimination with partial pivoting rounding to three significant digits. Clearly mention all the steps.

$$0.007x + 61.2y + 0.093z = 61.3$$
$$4.81x - 5.92y + 1.11z = 0.0$$
$$81.4x + 1.12y + 1.18z = 83.7$$

2. Solve the following system of equation by LU Factorization technique.

$$10x - 7y + 3z + 5u = 6$$
$$5x - 9y - 2z + 4u = 7$$
$$3x + y + 4z + 11u = 2$$
$$-6x + 8y - z - 4u = 5$$

3. What is a criterion for solving a system of linear equation by Gauss-Siedel method? Use Gauss-Siedel method to solve the following system of equations for five numbers of iterations using initial guesses as $x = y = z = 0.0$

$$5x + 2y + z = 12$$
$$x + 4y + 2z = 15$$
$$x + 2y + 5z = 20$$

4. Find the root of the equation: $e^x - 3x = 0$ within the range [0,1] using Bisection method. Perform six iterations.

5. What are the advantages and disadvantages of Newton-Raphson method in solution of nonlinear equation? Find a root of the equation: $x^3 - x - 1 = 0$ which lies between 1.0 and 2.0 using Newton Raphson technique.

6. Use the method of Least square to fit a curve of the form: $y = ab^x$ to the following data

x	1	2	3	4	5	6
y	151	100	61	50	20	8

Ref. No. : Ex/ChE/T/214/2018

Part II

Assume any missing data

(Use Separate Answer scripts for each part)

Answer Q.5 and any three from the rest

1. Using Lagrangian interpolation, obtain a third degree polynomial for the vapour pressure of acetone which could be used for 259.2K ≤ T ≤ K.

T (K)	259.2	273.4	290.1	320.5	350.9	390.3	446.4	470.6	508.1
p_{sat}(bar)	0.04267	0.09497	0.21525	0.74449	2.01571	5.655	17.682	26.682	47.000

[10]

2. Solve the differential equation with y (0) = 10, y (10) = 6 and Δx= 2.

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - \frac{y}{2} - 2.5 = 0$$

[10]

3. The values of y_i at x_i= 1, 3, 4 and 6 are 7, 53, 157, and 857 respectively. Construct a divided differences table and find a 3rd degree polynomial which fits these data points. [10]

4. If $f(x) = \cos(x)$ with h= 0.1, 0.1, and 0.01, find approximations to $f''(0.8)$ and compare with the true value $f''(0.8) = -\cos(0.8)$. Choose the best value of h.

[10]

5. Consider the ODE $\begin{bmatrix} y_1' \\ y_2' \end{bmatrix} = \begin{bmatrix} -100 & 0 \\ 2 & -1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$ with $y_0 = [2 \quad 1]^T$. Use explicit Euler technique with h=0.02 to obtain y ($t_1 = 0.02$).

Integrate the ODE by hand (h= 0.02). Compare the results and comment.

[20]