B.E. Chemical Engineering Second Year Second Semester Examination 2024

Numerical Analysis for Chemical Engineers

Time: Three hours **Full Marks: 100**

Note: 1. All part questions should be done in one place

2. Assume any missing data

1. **CO 1: Answer the questions**

a) Differentiate between bracketing and open methods to solve non-linear algebraic equations. Name the methods used in numerical analysis. [4]

b) Explain the Gauss-Siedel method and its convergence criteria. [4]

c) Differentiate between interpolation and regression technique. List out the interpolation methods, which can be used when at unequal interval data points are available. [4]

d) What do you mean by boundary value problem in solving the ordinary differential equation? [3]

2. **CO 2: Answer any THREE questions**

a) Solve the following system of equations using the method of Gauss Elimination with partial pivoting. [10]

$$2x+y+z=10$$
$$x+2y+3z=18$$
$$x+4y+9z=16$$

b) Solve the following system of equations by Gauss-Siedel method [10]

$$5x+y-z=10$$
$$2x+4y+z=14$$
$$x+y+8z=20$$

c) Using Regula-Falsi method, find the root of the equation $x^3-4x-9=0$ lies between 2 and 3. [10]

d) Find $\sqrt[3]{48}$ using Newton Raphson method correct up to 5 decimal places. [10]

3. **CO 3: Answer any THREE questions**

a) An experiment was performed and the values of heat capacity C_p at various temperatures T for a gas was found. [10]

T	-50	-30	0	60	90	110
C_p	1270	1280	1350	1480	1580	1700

Determine a linear model to predict C_p as a function of T.

b) Use Lagrange's interpolation formula to find the value of y when $x = 10$ from the following data table: [10]

x	5	6	9	11
y	12	13	14	16

c) Use Newton's forward interpolation formula, find the value of $f(1.6)$. Also find $f'(1.0)$. [10]

x	1.0	1.4	1.8	2.2
$f(x)$	3.49	4.82	5.96	6.5

d) i) Derive formula for Trapezoidal rule of numerical integration. [4]

ii) Following table shows speed in m/s and time in second of a car. Using Simpson's 1/3 rule, find the distance travelled by the car in 120 seconds. [6]

t	0	12	24	36	48	60	72	84	96	108	120
V	0	3.6	10.08	18.90	21.60	18.54	10.26	5.4	4.5	5.4	9.0

4. CO 4: Answer the question

a) Using Runge-Kutta method of order four with h = 1 find y (2), given $y' = y - x^2, y(0) = 1.5$ [10]

5. CO 5: Answer the question

a) Solve the following problem using the finite difference method and central difference approximation: [15]

$$\frac{d^2y}{dx^2} - y = -4xe^x, y(0) = 0, y(1) = 1 \text{ with } h = 0.25$$