Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140510 Date:13-07-2023

Subject Name:Numerical Methods in Chemical Engineering

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Explain three sources of arising errors in numerical computation.	**03**
	(b)	Re-arrange the given equations in diagonally dominant form and solve the new linear system by using Gauss Seidel Method with $X_0 = [0\ 0\ 0]$. Perform only three iterations. Calculate $\varepsilon_a = max[\varepsilon_{a,x}, \varepsilon_{a,y}, \varepsilon_{a,z}]$ only in the last iteration. $2x + 15y - 3z = 16, \quad 2x - 3y + 25z = 23, \quad 12x + 2y + z = 27.$	**04**
	(c)	Fit a second degree polynomial using least square method to the following data	**07**

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

Q.2	**(a)**	In calculating the area of a rectangle, an error of 3% is made in measuring each of its sides. Find the percentage error in calculating area of the rectangle.	**03**
	(b)	Find a root of the function $f(x) = \cos x - xe^x$ using Bisection Method. Perform only four iterations.	**04**
	(c)	Find the root of the equation $x^3 - 2x - 5 = 0$ using Secant method correct up to three decimal places.	**07**
		OR	
	(c)	Find a positive root of $x^3 - 4x + 1 = 0$ by the method of false position correct upto three decimal places.	**07**
Q.3	**(a)**	Explain the Gauss Jordan method to solve the system of linear equations.	**03**
	(b)	Fit a curve of the form $y = a\ e^{bx}$ to the following data:	**04**

x	1	3	5	7	9
y	115	105	95	85	80

	(c)	Using Newton- Raphson iterative method, find the real root of $x\ log_{10} x = 1.2$ correct to five decimal places.	**07**

OR

Q.3 **(a)** Determine the largest eigenvalue and the corresponding eigenvector of the matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. **03**

(b) Fit a curve of the form $y = ax^b$ to the following data: **04**

x	20	16	10	11	14
y	22	41	120	89	56

(c) Examine the system of equations **07**
$3x+3y+2z = 1,\ x+2y = 4,\ 10y+3z = -2,\ 2x-3y-z = 5$ for consistency and then solve it by Gauss Elimination method.

Q.4 **(a)** Construct the divided difference table with the arguments 2, 4, 9, 10 of the function $f(x) = x^3 - 2x$. **03**

(b) Using Newton's forward interpolation formula, find the value of $f(1.6)$. **04**

x	1	1.4	1.8	2.2
$f(x)$	3.49	4.82	5.96	6.5

(c) Find the polynomial $f(x)$ by using Lagrange's interpolation formula and hence find $f(3)$ for the below data: **07**

x	0	1	2	5
$f(x)$	2	3	12	147

OR

Q.4 **(a)** Derive formula for Trapezoidal Rule of numerical integration. **03**

(b) The residents of a town are given below. Estimate the residents for the year 1830 using Newton's backward interpolation. **04**

Year- x:	1791	1801	1811	1821	1831
residents –y: (in thousand)	46	66	81	93	101

(c) Using Modified Euler's method, find an approximate value of y when $x = 0.6$ with $h = 0.1$ given that $\frac{dy}{dx} = x + 3y,\ subject\ to\ y(0) = 1$. **07**

Q.5 **(a)** Find the approximate solution of $\frac{dy}{dx} = x + y,\ y(0) = 0$ with $h = 2$ using Euler's Method in five steps. **03**

(b) Evaluate $\int_0^3 \frac{1}{1+x}\,dx$ with $n = 6$ by using Simpson's 3/8 rule. **04**

(c) Using Milne's Predictor-Corrector Methods, find $y(4.4)$ given that $5xy' + y^2 - 2 = 0$ with $y(4) = 1, y(4.1) = 1.0049, y(4.2) = 1.0097, y(4.3) = 1.0143$. **07**

OR

Q.5 **(a)** Derive formula for Simpson's 1/3 Rule of numerical integration. **03**

(b) Use second order Runge Kutta method to compute $y(0.2)$ given that $\frac{dy}{dx} = x + \sqrt{y},\ y(0) = 4$ by taking h=0.1. **04**

(c) Use the Taylor series method to find $y(0.2)$, given that $\frac{dy}{dx} = 2y + 3e^x$, $y(0)=1$. Taking h=0.1. **07**

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