Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(NEW) EXAMINATION – WINTER 2022

Subject Code:3140510 Date:15-12-2022

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)**	Describe different types of errors.	**03**
	(b)	Fit the straight line that best fits to the following data:	**04**

x	1	2	3	4	6	8
y	2.4	3	3.6	4	5	6

			07
	(c)	Fit a second-degree parabola to the following data:	

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

Q.2	**(a)**	Prepare Forward difference table for the following data:	**03**

x	0	5	10	15	20	25
y	7	11	14	18	24	32

	(b)	Using Newton Raphson method, find the root of $x^4 - x - 10 = 0$ correct up to three decimal places.	**04**
	(c)	Using Secant method, find the root of $x^3 + x^2 - 3x - 3 = 0$ correct up to five decimal places starting from $x_0 = 1$ and $x_1 = 2$	**07**
		OR	
	(c)	Find the square root of 10 correct to three decimal places, by using Newton-Raphson iteration formula.	**07**
Q.3	**(a)**	Find the percentage error in computing the parallel resistance R of two resistances R_1 and R_2 if R_1 , R_2 are each in error by 2%.	**03**
	(b)	Find A^{-1} if A$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$	**04**
	(c)	Using Bisection method find the root of the equation $x^3 - 5x + 3 = 0$, correct up to two decimal places.	**07**
		OR	
Q.3	**(a)**	Explain the Gauss Jordan method to solve the system of linear equations.	**03**
	(b)	Solve the following system of equations by Gauss Elimination method: $x + 3y + 2z = 5$, $2x + 4y - 6z = -4$, $x + 5y + 3z = 10$	**04**

(c) Solve the following system of equations by Gauss-Jacobi method: **07**
$6x + 2y - z = 4$, $x + 5y + z = 3$, $2x + y + 4z = 27$

Q.4 **(a)** Using Euler's method find y (1.2), given that $\frac{dy}{dx} = x\sqrt{y},\ y(1) = 1$, Taking $h = 0.1$ **03**

(b) Apply 4th order Runge Kutta Method to compute y for $x = 0.5$, given that $\frac{dy}{dx} = \sqrt{x+y},\ y(0.4) = 0.41,\quad h = 0.1$ **04**

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

OR

Q.4 **(a)** Derive formula for Simpson's 1/3 rule of numerical integration. **03**

(b) Find the isothermal work done on the gas if it is compressed from $v_1 = 22L$ to $v_2 = 2L$. Use Trapezoidal rule to find $W = -\int_{v_1}^{v_2} p\ dv$ **04**

V(L)	2	7	12	17	22
P(atm)	12.20	3.49	2.049	1.44	1.11

(c) Evaluate $\int_0^3 \frac{dx}{1+x}$ by using Simpson's 3/8 Rule and hence calculate $log\ 2$ **07**

Q.5 **(a)** Prove that (1) $\Delta\nabla = (\Delta - \nabla)$ (2) $\Delta = E\nabla = \Delta E$ **03**

(b) Using Newton's divided difference formula, evaluate $f(9)$ from the following data: **04**

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

(c) Use Lagrange's interpolation formula to find the value of y when $x = 4$, if the values of x and y are given below: **07**

x	2	3	5	7
y	0.1506	0.3001	0.4517	0.6259

OR

Q.5 **(a)** Discuss in brief about boundary value problems. **03**

(b) Find $Y(2.36)$ from the following table using Newton's backward interpolation method. **04**

x	1.6	1.8	2	2.2	2.4	2.6
y	4.95	6.05	7.39	9.03	11.02	13.46

(c) Use Milne's predictor-corrector method to find $y(4.4)$. Given that $5xy' + y^2 - 2 = 0$, $y(4) = 1,\ y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0143$, with $h = 0.1$ **07**

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