Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 3 – EXAMINATION – SUMMER 2026

Subject Code: BE03005041 **Date: 02/07/2026**

Subject Name: NUMERICAL METHODS IN CHEMICAL ENGINEERING

Time: 02:30 PM TO 05:00 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.**

Q.1 **(a)** Find the relative error if the number X = 0.004997 is **03**
(i) truncated to three decimal digits
(ii) rounded off to three decimal digits.

(b) The area of cross-section of a rod is desired up to 0.2% error. How accurately should the diameter be measured? **04**

(c) Using the Runge-Kutta method of fourth order, solve for y at x = 1.2 and x = 1.4, given $x_0 = 1$, $y_0 = 0$. **07**

$$\frac{dy}{dx} = \frac{2xy + e^x}{x^2 + xe^x}$$

Q.2 **(a)** Describe intermediate value properties. **03**

(b) Explain algorithm for finding the root of an equation using Newton-Raphson method. **04**

(c) Use the method of false position, to find the fourth root of 32 correct to three decimal places. **07**

OR

Q.2 **(c)** Using the bisection method find a positive real root of, **07**

$$x \log_{10} x = 1.2$$

Q.3 **(a)** Explain in brief about ordinary differential equations - boundary value problems. **03**

(b) The velocity v(km/min) of a moped which starts from rest, is given at fixed intervals of time t (min) as follows, Estimate approximately the distance covered in twenty minutes. **04**

t:	2	4	6	8	10	12	14	16	18	20
v:	10	18	25	29	32	20	11	5	2	0

(c) Solve the equations using Gauss-Jordan method. **07**

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

OR

Q.3 **(a)** List out the interpolation methods, which can be used when data points are available at unequal intervals. **03**

(b) A solid of revolution is formed by rotating about the x-axis, the area between the x-axis, the lines x = 0 and x = 1 and a curve through the points with the following co-ordinates, Estimate the volume of the solid formed using Simpson's rule. **04**

x:	0.00	0.25	0.50	0.75	1.00
y:	1.0000	0.9896	0.9589	0.9089	0.8415

(c) Find the eigenvalues and eigenvectors of the matrix, **07**

$$A = \begin{bmatrix} 8 & -6 & 3 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$

Q.4 **(a)** Write an algorithm for trapezoidal rule. **03**

(b) An experiment gave the following values, It is known that v and t are connected by the relation $v = at^b$. Find the best possible values of a and b. **04**

v (ft/min):	350	400	50	600
t (min):	61	26	7	2.6

(c) Find the maximum and minimum value of y from the following data: **07**

x:	– 2	– 1	0	1	2	3	4
y:	2	– 0.25	0	– 0.25	2	15.75	56

OR

Q.4 **(a)** Describe Milne's predictor-corrector method. **03**

(b) Find the least squares fit of the form $y = a_0 + a_1x^2$ to the following data, **04**

x:	– 1	0	1	2
y:	2	5	3	0

(c) A slider in a machine moves along a fixed straight rod. Its distance x cm along the rod is given below for various values of the time t seconds. Find the velocity of the slider and its acceleration when t = 0.3 second. **07**

t =	0	0.1	0.2	0.3	0.4	0.5	0.6
x =	30.13	31.62	32.87	33.64	33.95	33.81	33.24

Q.5 **(a)** Using Euler's method, find an approximate value of y corresponding to x = 1, given that dy/dx = x + y and y = 1 when x = 0. **03**

(b) Using Milne's method find y(4.5) given $5xy' + y^2 - 2 = 0$ given y(4) = 1, y(4.1) = 1.0049, y(4.2) = 1.0097, y(4.3) = 1.0143, y(4.4) = 1.0187. **04**

(c) Solve $x^4 - 5x^3 + 20x^2 - 40x + 60 = 0$, by Newton's method given that all the roots of the given equation are complex. **07**

OR

Q.5 **(a)** Determine f(x) as a polynomial in x for the following data: **03**

x:	– 4	– 1	0	2	5
$y = f(x)$:	1245	33	5	9	1335

(b) Using Lagrange's formula, express the given function, a sum of partial fractions. **04**

$$\frac{3x^2 + x + 1}{(x-1)(x-2)(x-3)}$$

(c) Solve by Taylor's series method, here y(1.1) and y(1.2), given y(1) = 2. **07**

$$\frac{dy}{dx} = \log(xy)$$

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