Seat No.: ________ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2140505 **Date:09/05/2019**

Subject Name: Chemical Engineering Maths

Time:02:30 PM TO 05:30 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) Define the following terms: **03**
1. Accuracy
2. Precision
3. Truncation Error

(b) Solve the following system of equations by Gauss Elimination method: **04**
$2x+2y-2z=8; \quad -4x-2y+2z=-14; \quad -2x+3y+9z=9$

(c) Explain diagonally dominant system. Use Gauss –Seidel method to solve the system of equations up to three decimal places: **07**
$2x+15y+6z=72\,; \quad 54x+y+z=110\,; \quad -x+6y+27z=85$

Q.2 (a) Evaluate the sum $\sqrt{6}+\sqrt{7}+\sqrt{8}$ and find its percentage relative error. **03**

(b) Find a real root of the equation $x^3+x^2-1=0$ using the bisection method correct upto three decimal places. **04**

(c) Discuss Newton-Raphson method geometrically. Find a real root of the equation $e^x-3x=0$ up to two decimal places using Newton-Raphson method. Take $x_0=0$. **07**

OR

(c) Derive secant method. Find the root of the equation $e^{-x}-\tan x=0$ using the secant method correct up to three decimal places. Take $x_0=1, x_1=0.7$. **07**

Q.3 (a) Write an algorithm for Newton-Raphson method. **03**

(b) Find a real root of the equation $x^3-9x+1=0$ in the interval [2, 3] by the regula falsi method. **04**

(c) Discuss about the pitfalls of Gauss elimination method and techniques for improvement. **07**

OR

Q.3 (a) Prove that (i) $\Delta=E-1$, (ii) $E=e^{hD}$ **03**

(b) Fit a straight line to the following data: **04**

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

(c) Explain the principle of least squares and using it fit an exponential curve $y=ae^{bx}$ to the following data : **07**

x	0	2	4	6	8
y	150	63	28	12	5.6

Q.4 **(a)** Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule with $h = 0.2$. **03**

(b) Using Newton's backward difference interpolation formula find $f(0.40)$ from the following table: **04**

x	0.10	0.15	0.20	0.25	0.30
f(x)	0.1003	0.1511	0.2027	0.2553	0.3093

(c) Using Lagrange's interpolation formula, find the interpolating polynomial from the following table: **07**

x	0	1	3	4
y	-12	0	12	24

OR

Q.4 **(a)** Write an algorithm of Simpson's 1/3 rule. **03**

(b) Apply Euler's method to solve the initial value problem **04**

$$\frac{dy}{dx} = \frac{x-y}{2}, \text{ where } y(0) = 1$$

over [0, 3] using step size 0.5.

(c) Write the formula for divided differences $[x_0, x_1]$ and $[x_0, x_1, x_2]$. Using Newton's divided difference formula find $f(9)$ from the following table: **07**

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

Q.5 **(a)** Define first, second and mixed boundary value problems for elliptic equations. **03**

(b) Find $\frac{dy}{dx}$ at $x = 1.30$ from the following data: **04**

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y	1.0000	1.0247	1.0488	1.0723	1.0954	1.1180	1.1401

(c) Apply fourth order Runge-Kutta method to find approximate value of y for $x = 0.2$, in steps of 0.1, if $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$. **07**

OR

Q.5 **(a)** Explain finite difference approximations to partial derivatives. **03**

(b) Determine whether the following partial differential equations are elliptic, parabolic or hyperbolic: **04**

1. $\frac{\partial^2 u}{\partial x^2} + 2\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = e^{x+y}$
2. $5\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial y^2} = \sin(3x + 4y)$

(c) Using Gauus Seidel method up to three iterations solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the following square plate with boundary values as shown in the figure: **07**

u =0

	P_{02}	P_{12}	P_{22}	
u=100	P_{01}	P_{11}	P_{21}	u =100
		P_{10}	P_{20}	

u =100

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