Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

Subject Code:2140505 **Date:22/11/2018**

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)** Explain false position method. **03**

(b) Differentiate between bracketing and open methods to solve non-linear algebraic equations. **04**

(c) Find root of the equation $x^3 - 2x - 5 = 0$ using bisection method. **07**

Q.2 **(a)** Define: (1) Coefficient of determination, (2) Correlation coefficient, and (3) standard error of estimate **03**

(b) Explain Gauss elimination method with its pitfalls. **04**

(c) Use Gauss-Jordan technique to solve the following three equations. **07**

$$3x_1 - 0.1x_2 - 0.2x_3 = 7.85$$
$$0.1x_1 + 7x_2 - 0.3x_3 = -19.3$$
$$0.3x_1 - 0.2x_2 + 10x_3 = 71.4$$

OR

(c) Solve following equations using Newton-Raphson technique, starting with $x_0^T = [0.5 \quad 0.5]$. Carry out two iterations. **07**

$$f_1(x_1, x_2) = 4 - 8x_1 + 4x_2 - 2x_1^3 = 0$$
$$f_2(x_1, x_2) = 1 - 4x_1 + 3x_2 + x_2^2 = 0$$

Q.3 **(a)** Given a value of $\tilde{x} = 2.5$ with an error of $\Delta\tilde{x} = 0.01$, estimate the resulting error in the function, $f(x) = x^3$ **03**

(b) Explain the following terms with suitable example: **04**
(1) Significant figures, (2) Relative error

(c) Use Jacobi's method to solve the following three equations with initial values $x_1 = x_2 = x_3 = x_4 = 0$. Carry out three iterations. **07**

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

OR

Q.3 **(a)** Explain Gauss-Seidel method. **03**

(b) Suggest method to plot the variables y and x, given in the following equation, so that data fitting the equation will fall on straight line. **04**

$$y = \frac{\alpha x}{1 + x(\alpha - 1)}$$

(c) Table below gives the temperatures (T) and length (L) of heated road. If $L = a_0 + a_1 T$, find the best values of a_0 and a_1 using linear regression. **07**

T, ^{0}C	20	30	40	50	60	70
L, mm	800.3	800.4	800.6	800.7	800.9	801

Q.4 **(a)** Explain Simpson's 3/8th rule. **03**

(b) Explain Newton's divided difference interpolation method. **04**

(c) Using Newton's forward difference formula and data given in the table below, estimate vapor pressure of ammonia vapor at 23°C. The latent heat of ammonia is 1265 kJ/kg. **07**

Temperature, °C	20	25	30	35
Pressure, kN/m^2	810	985	1170	1365

OR

Q.4 **(a)** From the following table of values of x and y , obtain dy/dx for x=1.2 **07**

x	1	1.2	1.4	1.6	1.8	2	2.2
Y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

(b) Water is flowing through a pipe line 6 cm in diameter. The local velocities (u) at various radial positions (r) are given below: **07**

u, cm/s	2	1.94	1.78	1.5	1.11	0.61	0
r, cm	0	0.5	1	1.5	2	2.5	3

Estimate the average velocity $\bar{u}$, using Simpson's 1/3rd rule.

The average velocity is given by: $\bar{u} = \frac{2}{R^2}\int_0^R u\, r\, dr$, where R is radius of pipe.

Q.5 **(a)** Explain Milne's predictor corrector method. **03**

(b) Explain procedure to solve following heat conduction equation using finite difference technique. **04**

$$k\frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$$

(c) Solve the following 3rd order ordinary differential equation using Euler method. At time, t = 0, initial guess values are $x_{1_0} = 2,\ x_{2_0} = 16,\ x_{3_0} = 4$. Use time interval from 0 to 1 second, with step size h = 0.5 sec. **07**

$$\frac{d^3x}{dt^3} + 4\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + 16x = 21$$

OR

Q.5 **(a)** Consider general linear 2nd order partial differential equation given below. **03**

$$a\frac{\partial^2 C}{\partial r^2} + b\frac{\partial^2 C}{\partial r\,\partial z} + d\frac{\partial^2 C}{\partial z^2} + e\frac{\partial C}{\partial r} + f\frac{\partial C}{\partial z} + gC = h$$

where, a, b, d, e, f, g and h are functions of r, z and their derivatives. How to check, whether given partial differential equation is parabolic, hyperbolic or elliptic?

(b) Explain modified Euler's method. **04**

(c) Solve the following set differential equations using fourth order Runge-Kutta method assuming that at x=0, y_1=4 and y_2=6. Integrate to x=1 with a step size of 0.5. **07**

$$\frac{dy_1}{dx} = -0.5y_1 \qquad \frac{dy_2}{dx} = 4 - 0.3y_2 - 0.1y_1$$

****