GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3140510   **Date:29-06-2022**
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.**

Q.1	**(a)**	Explain following terms: 1) Significant figures, 2) Truncation Error.	**03**
	(b)	Define: 1) Absolute error, 2) Relative error, 3) Percentage error, 4) Inherent Error.	**04**
	(c)	Evaluate sum $S = \sqrt{4} + \sqrt{6} + \sqrt{8}$ to four significant digits and find absolute & relative errors.	**07**

Q.2	**(a)**	Describe intermediate value properties.	**03**
	(b)	Find the root of equation $x \log_{10} x = 1.2$ correct upto four decimal places using bisection method.	**04**
	(c)	Enlist limitations of Newton-Raphson Method also find root of the function $x^4 - x = 10$ upto three decimal places using Newton-Raphson method.	**07**

OR

	(c)	Solve following equation using Newton Raphson technique starting with $x_0 = 0.5 \ and \ y_0 = 1.5$, carry out two iterations.	**07**

$$\sin x - y = -0.9793$$
$$\cos y - x = -0.6703$$

Q.3	**(a)**	Explain Gauss elimination method with its pitfalls.	**03**
	(b)	Solve the system of equation using Gauss Jordan method. $2x + y + z = 10; 3x + 2y + 3z = 18; x + 4y + 9z = 16$	**04**
	(c)	Solve following set of equation using jacobi's iteration method correct up to three decimal places. $x_0 = y_0 = z_0 = 0$	**07**

$$20x + y - 2z = 17$$
$$3x + 20y - z = -18$$
$$2x - 3y + 20z = 25$$

OR

Q.3	**(a)**	Give the normal equation to fit the straight line $y = a + bx$ to n observations.	**03**
	(b)	Find the eigen-values and eigenvectors of the matrix	**04**

$$\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$$

	(c)	The pressure and volume of a gas are related by the equation $pV^\gamma = k$, γ and k being constants. Fit this equation to the following set of observations:	**07**

p (kg/cm²)	0.5	1.0	1.5	2.0	2.5	3.0
V (lts)	1.62	1.00	0.75	0.62	0.52	0.46

Q.4 **(a)** Establish Newton's backward interpolation formula.   **03**

(b) If P is pull required to lift a load W by means of a pulley block, find a linear law of form $P = mW + C$ connecting P & W, using following data.   **04**

P	12	15	21	25
W	50	70	100	120

(c) Obtain the density of a 26% solution of H_3PO_4 in water at 20 °C during using Lagrange's interpolation formula can we perform the same calculation using Newton's forward difference interpolation formula? Yes or No?   **07**

y (Density)	1.0764	1.1134	1.2160	1.3350
x % H_3PO_4	14	20	35	50

OR

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

(b) Using Newton's backward difference formula, construct an interpolating polynomial of degree 3 for the data: $f(-0.75) = -0.0718125, f(-0.5) = -0.02475, f(-0.25) = 0.3349375, f(0) = 1.10100$.   **04**

(c) Evaluate $\int_0^{0.6} e^{-x^2}$ using the trapezoidal rule and Simpson's 1/3rd rule, taking $h = 0.1$ **07**

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

(b) Compute the value of $\int_{0.2}^{1.4}(\sin x - \log x + e^x)dx$ using Simpson's 3/8 rule.   **04**

(c) Using Euler's method, find an approximate value of y corresponding to $x = 1$, given that $dy/dx = x + y$ and $y = 1$ when $x = 0$.   **07**

OR

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

(b) Apply the Runge - Kutta fourth order method to find an approximate value of y when $x = 0.2$ given that $dy/dx = x + y$ and $y = 1$ when $x = 0$.   **04**

(c) Solve by Taylor's series method the equation $\frac{dy}{dx} = \log(xy)$ for y(1.1) and y(1.2), given y(1) = 2.   **07**

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