Duration: 3hrs **[Max Marks: 80]**

N.B. : (1) Question No. 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt **any FOUR** **[20]**

a Discuss the different types of errors occurring in numerical computation.

b Solve the following system of equations using Gauss elimination method.

$$4x + 3y + 5z = 15$$
$$2x - 7y - 8z = 20$$
$$x + 8y - 4z = 12$$

c Find the real root of $x \log_{10} x = 2.1$ correct to four decimal places using Newton-Raphson method.

d Explain Fuzzy Logic Systems architecture.

e A body is in the form of a solid of revolution, whose diameter D in cm of its sections at various distances x cm from one end is given in the table below. Compute the volume of the solid using Simpson's 1/3 rule.

X (cm)	0.0	2.5	5.0	7.5	10.0	12.5	15.0
D (cm)	5.00	6.00	7.00	8.00	9.00	10.00	4.00

f Consider an infinite string of linear density, m = 0.1 kg/m under a tension of T = 4.5 N. Determine the wave speed when a small transverse displacement is set-up in the string.

2 **a** **[10]**

(i) Compute the value of $s = \sqrt{\frac{a^2 * \sqrt{b}}{c^3}}$ when a = 6.54 ± 0.01, b = 48.64 ± 0.02 and c = 13.5 ± 0.03. Also find the relative error in the result.

(ii) Find a real root of the equation $x^3 - x - 11 = 0$ using Bisection method.

b Obtain the largest eigen value and the corresponding eigen vector of the matrix: **[10]**

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

3 **a** (i) An accelerator is constructed by suspending a mass of 0.5 kg from a spring of stiffness 12000 N/m with negligible damping. When mounted on the foundation of an engine, the peak-to-peak travel of the mass of the accelerator is observed as 10 mm at an engine speed of 1500 rpm. Determine the maximum displacement, maximum velocity and maximum acceleration. **[10]**

(ii) Using Milne's method, obtain y (0.4) given that $dy/dx = y - {}^{2x}/_{y}$

x	0	0.1	0.2	0.3
y	1	1.2662	1.5747	1.9983

b Compute the Lagrange's polynomial for the following data and hence obtain $f(8)$. **[10]**

x	5	6	9	11
$f(x)$	12	13	14	16

4 **a** (i) Solve the following system of equations by LU Decomposition method (Crout's method) **[10]**

$$2x - 6y + 8z = 24$$
$$5x + 4y - 3z = 2$$
$$3x + y + 2z = 16$$

(ii) A function $y = f(x)$ is given by the following table. Obtain $f(5.2)$ using Newton's backward difference method.

x	0	1	2	3	4	5	6
$f(x)$	176	185	194	203	212	220	229

b Obtain expression for 1-Dimensional steady state heat conduction with internal heat generation using Crank-Nicholson method. **[10]**

5 **a** (i) Evaluate and interpret condition number for $f(x) = e^{-x}$ at x = 7. **[10]**
(ii) What is a sampling distribution. Explain mean of sampling distribution of the mean.

b Use Secant method to compute the root of the equation. **[10]**

$$xe^x - \cos 2x - 0.82 = 0$$

after 5 iterations. Take initial guesses as 0 and 1.

6 **a** Compare the value of **[10]**

$$\log_e 2 = \int_1^2 \frac{dx}{x}$$

taking 4 equal intervals in (1, 2) obtained using Trapezoidal rule and Simpson's 1/3 rule.

b (i) Using Stefan-Boltzmann expression, estimate the rate of radiation of energy, H from a surface, as in $H = Ae\sigma T^4$ where H is in watts, A = surface area (m^2), e = emissivity that characterizes the emitting properties of the surface (dimensionless), σ = Stefan-Boltzmann constant (= 5.67 x 10-8 W/m^2K^4), and T = absolute temperature (K). Compute the error of H for a copper sphere plate with radius, r = 0.15 ± 0.01 m, e = 0.90 ± 0.05, and T = 550 ± 20 K. **[10]**
(ii) Solve the following system of equations using Gauss-Seidel method

$$28x + 4y - z = 32$$
$$x + 3y + 10z = 24$$
$$2x + 17y + 4z = 35$$

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