Name:

Enrolment No:

UPES
End Semester Examination, December 2024

Course: B.Tech. Mechanical Engineering **Semester: III**
Program: Computational Methods **Time : 03 hrs.**
Course Code: MECH2080 **Max. Marks: 100**

Instructions: Compute all the answers up to three decimal places, wherever applicable.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Illustrate the convergence criteria of the *Newton Raphson Iteration Method.*	**04**	**CO1**
Q 2	Prove that $\Delta . \nabla = \Delta - \nabla$	**04**	**CO2**
Q 3	Compute $f'(1)$ for the data given in the following table: x: 1, 2, 3, 4, 5, 6 y: 1, 8, 27, 64, 125, 216	**04**	**CO3**
Q 4	Write the algorithm of the *LU Decomposition* method.	**04**	**CO4**
Q 5	Given $\frac{dy}{dx} = xy$, with the initial conditions $y(0) = 1$. Find $y(0.4)$ by Euler's Method taking the step length $h = 0.2$.	**04**	**CO5**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Evaluate a root of the following equation $\sin(x) + \cos(x) = 1$ using Regula Falsi Method up to fourth iteration.			**10**	**CO1**
Q 7	(a) Find the value of $y(3)$, using Lagrange's method. x: -1, 0, 2, 5 y: 9, 5, 3, 15			**10**	**CO2**

Q 8	Evaluate the integral $\int_{1.2}^{1.6} \left(x + \frac{1}{x}\right) dx$ using (i) Trapezoidal rule and (ii) Simpson's rule taking four intervals.	**10**	**CO3**
Q 9	(a) Solve the following boundary value problem: $y'' + y = 0, y(0) = 0, y(\pi) = 4.$ **OR** (b) Solve the equation $u_{tt} = 16u_{xx}$ subject to the conditions $u(x, 0) = x^2(5 - x)$, $u_t(x, 0) = 0$, $u(0, t) = u(5, t) = 0$, using Crank Nicolson method taking $\Delta x = 1$ upto t=1.25.	**10**	**CO6**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	(a) Solve the following system of equations by LU Decomposition method: $27\,x_1 + 6\,x_2 - x_3 = 85.10$ $6\,x_1 + 15\,x_2 + 2\,x_3 = 72.00$ $x_1 + x_2 + 54\,x_3 = 110.22$ **OR** (b) Use Gauss Seidel Method to solve the following system (up to fourth iteration). $7\,x_1 + 2\,x_2 - x_3 = 17.20$ $-x_1 + 9\,x_2 + 2\,x_3 = 18.90$ $x_1 + 5\,x_2 - 11\,x_3 = 28.05$	**20**	**CO4**
Q 11	Given $\frac{dy}{dx} = x^2 + y^2$, with the initial conditions $y(1) = 0$. Find $y(1.3)$ by RK-4 Method taking the step length $h = 0.1$	**20**	**CO5**