Name: Enrolment No:	

UPES

End Semester Examination, May 2023

Course: Engineering Mathematics II — **Semester: II**
Program: B. Tech (FSE, Civil, & Sustainability Engineering) — **Time: 03 hrs.**
Course Code: MATH 1053 — **Max. Marks: 100**

Instructions: Read all the below mentioned instructions carefully and follow them strictly:
1) Mention Roll No. at the top of the question paper.
2) Attempt all the parts of a question at one place only.
3) Attempt all the questions from each section.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q.1.	Solve $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = e^{3x}$.	**4**	**CO1**
Q.2.	Classify the following second order partial differential equation: $$y^2\frac{\partial^2 z}{\partial x^2} - x^2\frac{\partial^2 z}{\partial y^2} = 0, \quad x > 0, y > 0.$$	**4**	**CO2**
Q.3.	Given that the equation $x^{2.2} = 69$ has a root between 5 and 8. Use the regular-falsi method to find the first approximate solution.	**4**	**CO3**
Q.4	Perform two iterations of bisection method to determine a root lying between 0 and 0.5 of the equation $4e^{-x}sinx - 1 = 0$.	**4**	**CO3**
Q.5	Find a real root of the equation $x^3 = 1 - x^2$ on the interval [0, 1] with an accuracy of 10^{-4}, using iteration method. Taking initial guess $x_0 = 0.75$.	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q.6.	Find the solution of PDE: $(mz - ny)\frac{\partial z}{\partial x} + (nx - lz)\frac{\partial z}{\partial y} = (ly - mx)$, where l, m, n are constants.	**10**	**CO2**

Q.7	Use the Newton-Raphson method to obtain a root, correct to four decimal places of the following equation (choose $x_0 = \pi$) $$x\sin x + \cos x = 0.$$	**10**	**CO3**
Q.8	Using the Newton's forward interpolation formula, find the cubic polynomial which takes the following values: $y(1) = 24, y(3) = 120, y(5) = 336,\ y(7) = 720$. Hence, or otherwise, obtain the value of $y(8)$.	**10**	**CO3**
Q.9	Estimate the value of the integral $I = \int_0^1 \frac{1}{x} dx$, using Simpson's-1/3 rule with step size $h = 0.25$. **OR** Using Euler's method, solve the following differential equation: $$\frac{dy}{dx} = xy, \quad y(0) = 0.$$ Choose $h = 0.1$ and compute $y(0.2)$.	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			
Q.10	**(*a*)** Solve the following second order Cauchy-Euler differential equations: $$x^2\frac{d^3y}{dx^3} + 3x\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^2 \log x.$$ **(*b*)** Examine whether the equation $(x+y)^2dx + (2xy + x^2 - y^2)dy$ is exact or not, if yes then solve it.	**10 + 10**	**CO1**
Q.11	Consider the first order differential equation $\frac{dy}{dx} = y - x$ with $y(0) = 2$, $h = 0.1$. Using the fourth order Runge-Kutta formula, find $y(0.1)$ and $y(0.2)$ correct to four decimal places. **OR** The table below gives the values of tan (x) for $0.10 \le x \le 0.30$: <table><tr><td>x</td><td>0.10</td><td>0.15</td><td>0.20</td><td>0.25</td><td>0.30</td></tr><tr><td>$y(x) = \tan(x)$</td><td>0.1003</td><td>0.1511</td><td>0.2027</td><td>0.2553</td><td>0.3093</td></tr></table>Using the Newton's forward difference formula, find the value of (a) $\tan(0.12)$ and (b) $\tan(0.26)$.	**20**	**CO3**