BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH
BRANCH: CSE/ECE/EEE

SEMESTER : IV/ADD
SESSION : SP/2025

SUBJECT: MA203 NUMERICAL METHODS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.

CO BL

Q.1(a) The deflection y of the top of a sailboat mast is $y = \frac{FL^4}{8EI}$, where F = a uniform side loading (N/m), L = height (m), E = the modulus of elasticity (N/m^2), and I = the moment of inertia (m^4). Estimate the error in y given the following data: [5] 1 2

$$F = 750 \pm 30, \quad L = 9 \pm 0.03, \quad E = 7.5 \times 10^9 \pm 5 \times 10^7, \quad I = 0.0005 \pm 0.000005.$$

Q.1(b) Use the secant method to estimate the root of $f(x) = e^{-x} - x$ correct upto four significant digit. Start with the initial estimate of $x_{-1} = 0 \; and \; x_0 = 1.0$. [5] 1 3

Q.2(a) Use the Gauss-Jordan method to solve the following system of equations : [5] 2 2

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

Q.2(b) Find the solution to the following system of equations using the Gauss-Seidel method. [5] 2 3

$$12x_1 + 3x_2 - 5x_3 = 1$$
$$x_1 + 5x_2 + 3x_3 = 28$$
$$3x_1 + 7x_2 + 13x_3 = 76$$

Use $(x_1, x_2, x_3) = (1,0,1)$ as the initial guess and the absolute relative approximate error should be less than 5% for each unknown.

Q.3(a) Find the distance moved by a particle at 4 seconds, if the time verses velocity data is as follows: [5] 3 2

t	0	1	3	4
v	21	15	12	10

Q.3(b) Using Newton's Divided difference formula, find the missing value of y from the table: [5] 3 3

x	1	2	4	5	6
y	14	15	5	---	9

Q.4(a) Compute $\int_0^1 \frac{sinx}{x} dx$ by using the composite trapezoidal rule with six uniform points. Take the value $\frac{sinx}{x} = 1 \; at \; x = 0.$ [5] 4 2

Q.4(b) Use 4-segment Simpson's 1/3 rule to approximate the distance covered by a rocket in meters from t=8s to t=30s as given by [5] 4 3

$$x = \int_8^{30} \left(2000 \ln \left[\frac{140000}{140000 - 2100t} \right] - 9.8t \right) dt$$

Q.5(a) Using modified Euler's method, find an approximate value of y when x=0.2, solve $\frac{dy}{dx} = x + y \; and \; y = 1 \; when \; x = 0$. Take h=0.1. [5] 5 2

Q.5(b) Using the Runge-Kutta method of fourth order, solve [5] 5 3

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2} \; with \; y(0) = 1 \; at \; x = 0.2, 0.4$$

:::::25/04/2025 M:::::