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

CLASS: MTECH & PRE-PHD **SEMESTER : I**
BRANCH: Civil **SESSION : MO/2023**

SUBJECT: CE541 ANALYTICAL AND NUMERICAL METHODS IN STRUCTURAL ENGINEERING
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 hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	In the calculation of the volume of a cube of nominal size, the uncertainty in the measurement of each side is 10%. Evaluate the uncertainty in the measurement of the volume.	[5]	CO1	Analyze Evaluate
Q.1(b)	The formula for normal strain in a longitudinal bar is given by: $$\in = \frac{F}{AE}$$ where F = normal force applied, A = cross-sectional area of the bar, E = Young's modulus. If $F = 50 \pm 0.5\ \mathrm{N}$, $A = 0.2 \pm 0.002\ \mathrm{m}^2$, and $E = 210 \times 10^9 \pm 1 \times 10^9\ \mathrm{Pa}$, Determine the maximum error in the measurement of strain.	[5]	CO1	Analyze Evaluate
Q.2(a)	Using Newton's iterative method, find the real root of $x log_{10} x = 1.2$ correct to five decimal places.	[5]	CO2	Apply
Q.2(b)	Solve by Jacobis method, the equations starting with the solution (2,3,0): $$5x - y + z = 10$$ $$2x + 4y = 12$$ $$x + y + 5z = -1$$	[5]	CO2	Apply
Q.3	A simply supported beam carries a concentrated load P (kN) at its midpoint. Corresponding to various values of P, the maximum deflection Y (mm) is measured. The data are given below.	[10]	CO2	Apply

P:	100	120	140	160	180	200
Y:	0.45	0.55	0.60	0.70	0.80	0.85

Find a linear law of deflection in relation to the applied load.

Q.4(a)	A solid of revolution is formed by rotating about the x-axis, the area between the x-axis, the lines x = 0 and x = 1 and a curve through the points with the following co-ordinates:	[5]	CO2	Apply

x:	0.00	0.25	0.50	0.75	1.00
y:	1.0000	0.9896	0.9589	0.9089	0.8415

Estimate the volume of the solid formed using Simpson's rule.
Hint: Required volume of solid generated = $\int_a^b \pi y^2 dx$

PTO

Q.4(b) The upward velocity of a body is given as a function of time as [5] CO3 Apply

t, s	10	15	20	22
v, m/s	22	36	57	10

To find the acceleration at $t = 17$ s, a scientist finds a second-order polynomial approximation for the velocity and then differentiates it to find the acceleration. What will be the estimated acceleration in m/s^2 at $t = 17$ s.

Q.5(a) The velocity (m/s) of a body is given as a function of time (seconds) by [5] CO3 Apply

$$v(t) = 200\ln(1+t) - t,\ t \geq 0$$

Using Euler's method with a step size of 5 seconds, Determine the distance in meters traveled by the body from $t = 2$ to $t = 12$ seconds.

Q.5(b) Solve the above problem Q.5(a) by using the Runge-Kutta 2nd order Ralston method with a step size of 5 seconds. [5] CO3 Apply

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