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

CLASS: M.Sc./I.M.Sc. **SEMESTER : I/VII**
BRANCH: PHYSICS **SESSION : MO/2025**

SUBJECT: PH405 MODERN COMPUTATIONAL TECHNIQUES AND PROGRAMMING

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)	Explain the generalized Rolle's Theorem and the Mean Value Theorem.	[3+2]	1	1,2
Q.1(b)	Derive the expression for the minimum number of iterations required to get an accuracy within ε for the root of a function using the bisection method, given that the root is within the interval [a,b].	[5]	1	3
Q.2(a)	Describe the LU decomposition method for solving a set of linear algebraic equations.	[5]		2
Q.2(b)	Solve using Gauss elimination: 2x+y+z = 10 3x+2y+3z = 18 x+4y+9z = 16	[5]		3
Q.3(a)	What are forward, backward and central differences? How are the higher order forward differences defined in a forward difference table?	[3+2]	3	2
Q.3(b)	Show that in Newton's formula for interpolation, the coefficients are given by $a_i = \Delta^i y_0/(h^i\, i!)$.	[5]	3	2
Q.4(a)	Explain Gauss's forward interpolation formula.	[5]	4	2
Q.4(b)	The general formula for Newton's forward difference is given by $\int_{x_0}^{x_n} y\,dx = nh\left[y_0 + \frac{n}{2}\Delta y_0 + \frac{n(2n-3)}{12}\Delta^2 y_0 + \frac{n(n-2)^2}{24}\Delta^3 y_0 + \cdots\right]$. Explain the trapezoidal rule (n=1) as a special case of this formula.	[5]	4	3
Q.5(a)	Compare the Euler method with the modified Euler (Heun) method for solving ordinary differential equation.	[5]	5	2
Q.5(b)	What are the different categories of partial differential equations? Give an example of each.	[5]	5	1

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