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

CLASS: MTECH/PHD **SEMESTER: I**
BRANCH: CEE **SESSION: MO/2025**

SUBJECT: CE581 NUMERICAL METHODS AND COMPUTATIONAL TECHNIQUES

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)	Solve the following set of linear equations. Choose any method you find appropriate for the calculation. $$x + 3y - 2z = 6 \quad x + 3y - 2z = 6 \quad x + 3y - 2z = 6$$	[5]	1	K1 K2
Q.1(b)	Determine the largest eigen value and its corresponding eigen vector of the matrix utilizing the power method. $$A = \begin{bmatrix} 4 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix}$$			
Q.2(a)	Find a best fit linear curve for the following data set and find out the total error in approximation.	[5]	2	K2 K3

X	0.5	0.75	1	1.25	1.5	1.75	2.0	2.25	2.5
Y	0.293	0.49	0.885	1.563	2.657	4.376	7.095	11.55	19.41

Q.2(b)	Consider the following data set and find out the value of Y (1.3). Choose any method you find suitable.	[5]	2	K2 K3

X	0.6	0.72	1.14	1.56	1.83
Y	1	1.24	1.14	0.43	0.19

Q.3(a)	Derive the expression of double derivative (d^2y/dx^2) utilizing backward difference method.	[5]	3	K2 K3
Q.3(b)	Determine the displacement at the midspan of a simply supported beam under uniformly deformed load spanned over the whole length. Utilize central difference method. Consider h = 0.25 L; where L is the total length of the span.	[5]	3	K2 K3
Q.4(a)	Consider the Poisson equation over a region 0 < x < a; 0 < y < b. $$\frac{\delta^2\phi}{\delta x^2} + \frac{\delta^2\phi}{\delta y^2} = f(x,y)$$ Subjected to boundary conditions, $\phi_{\{x=0;y=0\}} = \phi_{00}; \phi_{\{x=a;y=0\}} = \phi_{a0}; \phi_{\{x=0;y=b\}} = \phi_{0b}; \phi_{\{x=a;y=b\}} = \phi_{ab}$ Derive the discretized form of the continuum equation using central difference method. Consider the step sizes as hx and hy in both the directions. $hx \neq hy$.	[10]	4	K2 K3
Q.5(a)	Derive the expression of Trapezoidal rule related to numerical integration of discrete data sets.	[5]	5	K2 K3
Q.5(b)	Determine the area under the curve with the following data set. Use Simpsons 3/8th rule for the calculation.	[5]	5	K2 K3

X	0.5	0.75	1	1.25	1.5	1.75	2.0	2.25	2.5
Y	0.293	0.49	0.885	1.563	2.657	4.376	7.095	11.55	19.41

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