MMDSE-1.5

Sl. No.

I Semester M.Sc. Degree Examination, October/November - 2025
MATHEMATICS
Numerical Analysis - 1
(CBCS SLM Scheme)

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

1. *Answer any Five full questions.*
2. *All questions carry equal marks.*

1. a) Derive secant method to find the root of f(x) = 0. Using the method find the smallest positive root of $x^3 - 5x + 1 = 0$ correct upto three decimal places. **(8+8)**

b) Using Chebyshev method find the root of the equation $\text{Cos}\, x - x\, e^x = 0$, correct to 5 decimal places. Use the initial approximation $x_0 = 1.0$.

2. a) Show that the rate of convergence of secant method is 1.618. **(8+8)**

b) Derive Newton - Raphson method to find the roots of the system of the non-linear equations *f(x,y) = 0* and *g(x,y) = 0*

3. a) Perform two iterations of the linear iteration method followed by one iteration of the Aitken Δ^2 method to find the root of the equation $f(x) = x^3 - 5x + 3 = 0, x_0 = 0.5$ **(8+8)**

b) Using the Sturm's sequence find the number of real and complex roots of the polynomial equation $x^4 - 4x^3 + 3x^2 + 4x + 1$.

4. a) Obtain Cholesky factorization of the matrix $\begin{bmatrix} 1 & 2 & 6 \\ 2 & 5 & 15 \\ 6 & 15 & 46 \end{bmatrix}$ **(8+8)**

b) Solve the following system of linear equation by using Gauss - Seidel method $4x + 2y + z = 14; x + 5y - z = 10; x + y + 8z = 20$

5. a) Describe Lagrange's interpolation method. Obtain the truncation error formula. **(8+8)**

b) Obtain Gregory Newton Forward Difference Interpolating polynomial. Write the truncation error for the same.

6. a) Obtain the Newton's bivariate interpolating polynomial for equispaced points. **(8+8)**

b) Obtain the Chebyshev polynomial approximation of second degree to the function $f(x) = x^3 on [0,1]$

[P.T.O.

7. a) The following data for a function f(x, y) is given **(8+8)**

y/x	0	1	3
0	1	2	10
1	2	4	14
3	10	14	28

Construct the Lagrange bivariate interpolating polynomial and hence find f(0.5, 0.5)

b) The following table of values is given :

x	-1	1	2	3	4	5	7
$f(x)$	1	1	16	81	256	625	2401

Using the formula $f'(x_1) = \left(f(x_2) - f(x_0)\right)/(2h)$ and the Richardson extrapolation, find $f'(3)$

8. a) Explain initial value problem method (Shooting method) **(8+8)**

b) Evaluate the integral

$$I = \int_{y=1}^{1.5}\int_{x=1}^{2} \frac{dxdy}{1+x}$$

Using the Simpson's rule with h = 0.5 (along x - axis) and K = 0.25 (along y - axis). Compare with exact solution.
