PG/IIS/MTM/297/25 (Pr.)

M.Sc. 2nd Semester Examination, 2025

APPLIED MATHEMATICS

(*Lab : C- Programming with Numerical Methods*)

(Practical)

PAPER – MTM-297

Full Marks : 25

Time : 2 hours

The figures in the right hand margin indicate marks

Answer any **two** questions which are selected by **lottery** : 10×2

1. Write a C program to find a real root of the equation

$$f(x) = x^3 - 6x^2 + 11x - 6$$

using Newton's method. Verify for initial guess $x_0 = 2.5$.

2. Write a C program to search for an element in a sorted array of size 10 using binary search technique.

3. Write a C program to solve a tri-diagonal system of equations using the Thomas algorithm (Tridiagonal matrix algorithm) :

$$2x_1 + 3x_2 = 5$$
$$3x_1 + 4x_2 + 2x_3 = 6$$
$$x_2 + 5x_3 = 7$$

4. Write a program in C to find the value of integration $\int_1^2 (x^2+1)dx$ by Simpson-$\frac{1}{3}$'s Rule.

5. Write a program in C to find the solutions of a system of linear equations

$$-3x_1 + x_2 - 5x_3 = -12$$
$$x_1 + 2x_2 + 4x_3 = 11$$
$$x_2 + 2x_3 = 5$$

by LU decomposition method.

(*Continued*)

6. Write a program in C to find $y(0.4)$ by solving the differential equation

$$\frac{dy}{dx} = x^2 - y^2, \quad y(0) = 1$$

by 4th order Runge-Kutta method using step length 0.1.

7. Write a program in C to arrange in descending order of a list of real numbers by insertion sort technique.

8. Write a program in C to find $f(2)$ by Lagrange Interpolation Technique given that $f(1) = 1.500$, $f(3) = 2.232$, $f(4) = 2.500$, $f(5) = 2.736$ and $f(6) = 2.949$.

9. Write a program in C to find the approximate largest Eigen value (in magnitude) and the corresponding Eigen vector of the following matrix by Power method

$$\begin{pmatrix} 2 & 3 & 1 \\ 3 & 2 & 2 \\ 1 & 2 & 1 \end{pmatrix}.$$

10. Write a program in C to find $y(0.4)$ by solving the differential equation

$$\frac{dy}{dx} = x - y, \; y(0) = 1$$

by Milne's Predictor Corrector method using step length 0.05.

11. Write a program in C to arrange in ascending order of a list of real numbers by selection sort technique.

12. Write a program in C to find $y(1.2)$ by solving the differential equation

$$\frac{dy}{dx} = x - y, \; y(0) = 1$$

by modified Euler method using step length 0.2.

13. Write a program in C to find the value of

$$\int_0^2 \frac{x}{1+x^2} dx$$

by using six point Gauss-Chebyshev quadrature formulae.

14. Write a program in C to compute $y(2.9)$ using Newton's backward interpolation formula given that $y(2.0) = 0.3010, y(2.2) = 0.3424, y(2.4) = 0.3802, y(2.6) = 0.4149, y(2.8) = 0.4471, y(3.0) = 0.4772.$

15. Write a program in C to find the value of

$$\int_0^2 \frac{x}{1+x^2} dx$$

by using six point Gauss-Legendre quadrature formulae.

16. Write a program in C to find the value of

$$\int_1^2 x^2 dx$$

by Monte Carlo method.

17. Write a C program to find $f(2.5)$ using Newton's forward interpolation formula. Given $x = 2.0,\ 2.2,\ 2.4,\ 2.6$ and $f(x) =$ 0.3010, 0.3424, 0.3802, 0.4149.

18. Write a program in C to find the solutions of a system of linear equations

$$\begin{aligned} -3x_1 + x_2 - 5x_3 &= -12 \\ x_1 + 2x_2 + 4x_3 &= 11 \\ x_2 + 2x_3 &= 5 \end{aligned}$$

by Gauss elimination method.

(*Continued*)

19. Write a C program to solve the following system of equations using Gauss-Seidel method (up to 3 iterations) :

$$x + y + z = 6$$
$$2x + 3y + 3z = 15$$
$$x + 2y + z = 10$$

20. Write a C program to perform selection sort on an array of floating-point numbers and count the number of swaps.

[Note book & Viva : 05]