2024
SRCMUJ
2nd Semester Examination
M. Sc.
Mathematics
MTM-296
Lab: Computational Methods Using C++ and MATLAB

Full Marks: 50 **Time: 4 hours**

The figures in the margin indicate full marks. Candidates are required to give their answers as far as practicable.

Group – A [C++]

[Note: Here R is your roll number]

A. Answer any one of the following questions which are selected by lottery: 20 × 1

1. Write a program in C++ to arrange in descending order of a list of real numbers by insertion sort technique.
2. Write a program in C++ to find $y(0.7)$ by solving the differential equation $\frac{dy}{dx} = -x^2 - Ry^2$, $y(0) = 1.2$ by 4th order R-K method using the step length 0.1.
3. Write a program in C++ to using operator overloading to find the first Fibonacci numbers.
4. Write a program in C++ to find the value of the integral $\int_{-R}^{R} (2x^3 + 5x - 23)\, dx$ by Simpson's $1/3$ rule.
5. Using C++ design a class for statistics with necessary numbers and the following membership functions: (a) get info for input (b) display for output (c) mean (d) median and (e) standard deviation of n numbers.
6. Write a program in C++ to find the solutions of a system of linear equations by Gauss-Seidal Method:

$$-3x_1 + x_2 - 5x_3 = R - 13$$
$$x_1 + 19x_3 = 9$$
$$R\,x_1 - x_2 + x_3 = 5$$

7. Write a program in C++ to design a class for student record with necessary numbers and functions. Use it to display the records of 11 students.
8. Write a program in C++ to arrange in ascending order of a list of real numbers by selection sort technique.
9. Write a program in C++ to find $y(2.1)$ by solving the differential equation $\frac{dy}{dx} = 11x - Ry$, $y(0) = 1$ by modified Euler method using the step length 0.3.

10. Write a program in C++ to find the approximate largest eigen value (in magnitude) and the corresponding eigen function of the following matrix by Power method

$$\begin{pmatrix} 2 & 1 & 3 \\ 5 & 2 & 0 \\ -1 & 1 & 7 \end{pmatrix}.$$

11. Write a program in C++ to compute $y(1.3)$ using Newton's forward interpolation formula given that

$$y(1.0)=0.1425,\ y(1.2)=0.1613,\ y(1.4)=0.2437$$
$$y(1.6)=0.3205,\ y(1.8)=0.3853,\ y(2.0)=0.4220.$$

Group – B [MATLAB]

[Note: Here R is your roll number]

B. Answer any two of the following questions which are selected by lottery: 10 × 2

1. Write a MATLAB script to find the solution of the following linear equations:

$6x+3y+7z+10w=3,\quad 3x-4y-8z+11.5w=8,\quad -x+40y+3z-10.3w=10.5$

2. Write a user defined function in MATLAB to calculate the roots of a general quadratic equation. Using it find the roots of the quadratic $5x^2+(R-17)x+R^2=0$, $R\in[0,10]$.
3. Write a script in MATLAB to represent the graph of the curve whose equation in polar coordinates is as follows: $r=\sin 4t\cos 4t$ for t between 0 and 3π. Mentioned the title, axes and axes limits.
4. Given two 2×2 matrices A and B, find (a) their matrix product, (b) their matrix right division (A divided by B), and (c) B raised to the third power element by element.
5. Write a script in MATLAB to draw the surface of the equation $z=x^2+y^2$ in the range $-R\le x\le R$ and $-(R+5)\le y\le(R+5)$. Also mentioned the title, axes and axes limits.
6. Find the eigenvalues, and for each eigenvalue determine the algebraic and geometric multiplicities of a given 3×3 matrix in MATLAB.
7. Write a script in MATLAB (mentioning the axes and axes limits) to draw the following function in the interval $[-R,\ 3R]$:

$$f(x)=\begin{cases} 2x^3-1, & -R\le x\le 0 \\ 0, & x=0 \\ x^2+7x+R, & x>0 \end{cases}.$$

8. Use two methods in MATLAB to create the vector x having 150 regularly spaced values starting at $-R$ and ending at $R+13$.

9. Write a script in MATLAB to draw $y = |x^3|$ and $y = x^5 + 4$ in the interval $[-R,\ R]$ in the same figure with different line specification. Also mentioned the title, axes and axes limits.
10. Write a script in MATLAB to create a real matrix and find it eigenvalues and eigenvectors.
11. Write a script in MATLAB to create two lists of numbers and perform the following arithmetic operations on it (i) addition (ii) subtraction (iii) element-wise multiplication (iv) element-wise division.
12. Write a script in MATLAB to create two matrices of real numbers and perform the following arithmetic operations on it (i) addition (ii) subtraction (iii) multiplication (iv) division.

Lab. Note Book and Viva-Voce: 10