

DHANAMANJURI UNIVERSITY

Examination- 2025 (June)

Four-year course B.A./B.Sc. 4th Semester (NEP)

Name of Programme	: B.A./B.Sc. Mathematics (Honours)	
Paper Type	: SEC (Theory)	
Paper Code	: SMA-008	
Paper Title	: Computer Algebra System and R Software	
Full Marks	: 30	
Pass Marks	: 12	Duration: 2 Hours

The figures in the margin indicate full marks for the questions.

Answer all the questions.

1. Choose and rewrite the correct answer for each of the following:

$$1 \times 4 = 4$$

- i) Which of the following is the correct syntax to define a function in Mathematica ?
 - a) $f(x) = x^2$
 - b) $f(x) := x^2$
 - c) $f[x_] := x^2$
 - d) $f[x] := x^2$
- ii) Which Mathematica command is used to find the value of constant π upto 20 digits ?
 - a) $N[Pi, 20]$
 - b) $N[pi, 20]$
 - c) $N[\{Pi\}^20]$
 - d) $N[20, Pi]$

iii) Which function displays the current working directory in R?

- a) getwd()
- b) setwd()
- c) dir()
- d) pwd()

iv) Which function is used to remove an object from the workspace?

- a) delete()
- b) rm()
- c) remove()
- d) del()

2. Write very short answer for each of the following: $1 \times 4 = 4$

- a) Write Mathematica command to find the product of first ten natural numbers.
- b) Write Mathematica command to construct a table of the first 10 prime numbers.
- c) How do you create a vector in R? Provide an example.
- d) Which R function is used to read a CSV file into a data frame? Provide an example.

3. Write short answer for each of the following: $3 \times 4 = 12$

- a) Write the uses of parentheses (), square brackets [] and curly brackets { } in Mathematica.
- b) Write Mathematica commands to find the solution of the initial value problem

$$\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2 = 0; y(0) = 1, y'(0) = 2$$

Also, write the output.

- c) Write Mathematica commands to define a function to generate the Fibonacci sequence and display the first 10 terms of the sequence.
- d) Explain the difference between a data frame and a matrix in R.

4. Answer the following:

$$6 \times 2 = 12$$

- a) Write the Mathematica commands to plot the function

$$f(x) = \begin{cases} x^2, & x > 0 \\ x, & x < 0 \end{cases}$$

in the interval $-2 \leq x \leq 2$ with plot range $-2 \leq x \leq 4$ and draw the rough diagram. Also, write Mathematica commands to differentiate and integrate the given function $f(x)$.

Or

Write Mathematica commands to manually row reduce the matrix given below showing the output matrix at each step:

$$A = \begin{pmatrix} 1 & -2 & -5 \\ 3 & 1 & -1 \\ 2 & 3 & -4 \end{pmatrix}$$

Also write Mathematica commands to find the determinant and rank of the given matrix A .

- b) How can you use R to detect if there is a relationship between two variables? Discuss visualization approaches available in R to establish the relationship.

Or

Discuss when you use a histogram and a line chart for describing data. Describe the steps involved in creating a histogram and a line chart using R's base graphics. Include the functions used and some common arguments for adding title of the plot, plot color, etc.
