DHANAMANJURI UNIVERSITY

Examination - 2024 (June)

Four-Year Course BA/B.Sc. 4th Semester

Name of Programme	:	**B.A/B.Sc. Mathematics**
Paper Type	:	**Core-SEC**
Paper Code	:	**SMA-008**
Paper Title	:	**Computer Algebra System**
Full Marks	:	**40**
Pass Marks	:	**16**
Duration	:	**2 Hours**

The figures in the margin indicate full marks for the questions
Answer the following questions:

1. Choose and rewrite the correct answer for each of the following: $1 \times 4 = 4$

a) Which command is used to find the determinant of a Matrix M in Mathematica?

    i)   det[M]
    ii) Det[M]
    iii) determinant[M]
    iv) Determinant[M]

b) Which command is used to find LU-decomposition of a Matrix M in Mathematica?

    i)   ludecomposition[M]
    ii) ludecomp[M]
    iii) LuDecomposition[M]
    iv) LUDecomposition[M]

c) Which key combination is used to run a line of code in a script file in RStudio?

    i) Shift + Enter
    ii) Ctrl + Enter
    iii) Ctrl + Shift + Enter
    iv) Enter

d) What will you type in the RStudio console window to get help on a topic in R?

    i) help(topic)
    ii) help('topic')
    iii) help.start()
    iv) apropos('topic')

2. Write very short answer for each of the following: $1 \times 6 = 6$

a) Write Mathematica command to find the value of the constant e up to 10 digits.

b) Write Mathematica command to find the sum of first ten natural numbers.

c) Write Mathematica command to display the identity matrix of order 3.

d) Write R command to plot a stem and leaf plot of a vector *height* containing the heights of 40 students.

e) Write R command to construct a data frame from vectors *score1* and *score2* and assign it to an R object.

f) Write R command to convert a data frame *bird.df* to a matrix and assign it to an R object.

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

a) Write Mathematica commands to define a function to generate the Fibonacci sequence and display the first 10 terms of the sequence.

b) Write Mathematica commands to define and plot the function below in the interval $-2 \le x \le 2$:

$$f(x) = \begin{cases} x & , & 0 \le x \le 1 \\ -x & , & -1 < x < 0 \\ 1 & , & \text{otherwise} \end{cases}$$

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c) Write Mathematica commands to create, display and plot a sparese array consisting of non-zero entries 1, 2, 3, 4 at positions (1, 2), (2, 4), (4, 6), (6, 8) respectively.

d) Write R commands to read data separated by tab contained in a file *fingerlings.txt* given below and display them. Write R commands to access the data in the three columns in three different ways.

	Pengba	Ngaton	Khabak
Loktak Pat	500	400	600
Tamu Pat	300	200	400
Pumlen Pat	300	200	300
Ikop Pat	200	300	200

4. Answer the following: $6 \times 3 = 18$

a)   i) Write Mathematica commands to plot the function $f(x) = \dfrac{1}{(x-1)(x-2)}$ in the interval $-3 \le x \le 6$ with plot range $-10 \le y \le 10$ excluding the points of discontinuities with dashed lines and labeling the x-axis ticks at intervals of 1 unit.

ii) Write Mathematica commands to make a three dimensional plot as well as the contour plot of the surface $z = e^{-(x^2+y^2)}$ in the region $-2 \le x, y \le 2$.

Or

i) Write Mathematica commands to define the function $f(x) = x^3 + \sin x$ and $f'(x), f''(x)$ and $\displaystyle\int_0^{\frac{\pi}{2}} f(x)dx$.

ii) Write Mathematica commands to find the solution to the initial value problem $\dfrac{d^2y}{dx^2} + 2\dfrac{dy}{dx} + y = 0; y(0) = 0, y'(0) = 1$ and plot the solution.

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

$$M = \begin{pmatrix} 1 & 1 & 4 & 25 \\ 2 & 1 & 0 & 7 \\ -3 & 0 & 1 & -1 \end{pmatrix}$$

Or

Write Mathematica commands to find the eigenvalues and eigenvectors of the matrix m, and hence find manually the diagonal matrix d and invertible matrix p so that p so that $m = p \cdot d \cdot p^{-1}$. Also write the Mathematica commands to get the matrices d and p directly, show them in matrix form and verify whether $m = p \cdot d \cdot p^{-1}$.

c) Write R commands to create a bar chart with labels from the following month-wise rainfall data:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain	4	6	8	12	18	24	20	22	14	8	4	6

Also, write R commands to summarize the rainfall data, find the standard deviation of rainfall data and check graphically whether the rainfall data is normally distributed.

Or

Write R commands to read marks of 40 students in two tests stored in the files *test1.txt* and *test2.txt* and compare the performance of the students in the two tests with the help of box whisker plot. Also, give R commands to find the correlation between the marks scored in the two tests and make a scatter plot of the two tests with the line of best fit.