

Name of Course : **CBCS B.Sc. Mathematical Sciences**
Unique Paper Code : **42353404_OC**
Name of Paper : **SEC-2 Computer Algebra Systems**
Semester : **IV**
Duration : **2 hours**
Maximum Marks : **38 Marks**

Attempt any four questions. All questions carry equal marks

1. State Collatz conjecture. Find the value of **Collatz**(5). Write the command to define and integrate the function $f(x) = x^2 + 3\cos x$. Write the command to extract the second element from the list $\{a, b, c, d\}$. Write the difference between `=` and `==`. Write the command to compute

$$\sum_{i=1}^n (i+1)^2.$$

2. What is the use of **Exclusion**, **Mesh**, **AspectRatio**, options while plotting? Write the command to plot the function $f(x) = 2(x-1)^2 + 1$ in the range $[0,5]$, axes origin should be at $(1,0)$, frame should be true and gridlines should be automatic. Explain the **Manipulate** command with example.
3. Write the commands to find the null space, eigen values, eigen vectors and rank of given matrix **A**. Also write commands to produce the following matrix using **ArrayFlatten**

$$\begin{pmatrix} 3 & 2 & 0 & 0 & 0 \\ 3 & 3 & 0 & 0 & 0 \\ 0 & 0 & 5 & 12 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & -3 \end{pmatrix}.$$

4. Write the command to factor the expression $f(x) = 1 + 5x + 2x^3 + 10x^4$. Write the command to find the approximate numerical roots of $f(x)$. What is the output of

Reduce[($a^2 + 5a + 6$) $x == 2, x$]. Write the command to find a root of the equation $\sin x = 2 - x^2$ near $x = 1.2$. What is **Epilog**, **ReplaceAll** commands?

5. Define the function $f(x) = \frac{\sin(\pi(x-2))}{x-2}$. Write the command to plot the function into the range $[-3,3]$. Write the commands to find the first, second and n^{th} derivative of $f(x)$. Write the command to integrate the function $f(x)$ in the range $[-3,3]$.
6. Write the command to plot the surface $z = e^{x^2+y^2}$, for $-2 \leq x, y \leq 2$. Write all the commands to find the extrema of the function $f(x) = x^3 - 3x + 6$ on the interval $[-3,3]$ using second derivative test.

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