INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
DEPARTMENT OF MATHEMATICS AND STATISTICS

MA635P-Scientific Programming Laboratory

Lab Exercise-7 (36 Marks) Deadline: 27 February 2025, 5:00 PM

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1. Create an algorithm for Forward Substitution. [2.5]
2. Create an algorithm for Backward Substitution. [2.5]
3. Create an algorithm for LU Decomposition. [2.5]
4. Create an algorithm for Doolittle/Crout Decomposition. [1]
5. Create an algorithm for Cholesky Decomposition. [2.5]
6. Write a Python code for the developed Forward Substitution and Solve the following linear system [5]

$$\begin{pmatrix} 6 & 0 & 0 & 0 \\ 12 & -8 & 0 & 0 \\ 3 & -24 & 9 & 0 \\ -6 & 4 & 18 & -18 \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix} = \begin{pmatrix} 16 \\ 26 \\ -19 \\ -34 \end{pmatrix}$$

7. Write a Python code for the developed Backward Substitution and Solve the following linear system [5]

$$\begin{pmatrix} 1 & -1/3 & 1/3 & 2/3 \\ 0 & 1/2 & -1/4 & -1/4 \\ 0 & 0 & 2/9 & -5/9 \\ 0 & 0 & 0 & 1/6 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} 8/3 \\ 3/4 \\ -1 \\ 1/6 \end{pmatrix}$$

8. Write a Python code for the developed LU Decomposition and Solve the following linear system [5]

$$\begin{pmatrix} 6 & -2 & 2 & 4 \\ 12 & -8 & 6 & 10 \\ 3 & -13 & 9 & 3 \\ -6 & 4 & 1 & -18 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} 16 \\ 26 \\ -19 \\ -34 \end{pmatrix}$$

9. Write a Python code for the developed Crout Decomposition and solve the above linear system [5]
10. Write a Python code for the developed Cholesky Decomposition and solve the above linear system $A^TAx = A^Tb$ [5]