

Assignment 1 - MTH501

Due Date: November 20, 2025

Total Marks: 20

Instructions:

- Attempt all the questions. Show all necessary steps and clearly mention any formulas or theorems used.
- Lectures 9 to 16 are covered in **Assignment 1**.
- **Assignment #1** has been posted on the Announcement page of **your section**. Submissions from any other section will **not be accepted** and will receive **zero marks**.
- Submitting a **copied assignment** or an **irrelevant assignment** will result in a **zero grade**.
- **Assignment 1 is due on November 20, 2025.**
- Properly write and upload the solution of this assignment in **MS Word** on the **LMS**.

Problem 1: Let $L : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be a linear operator defined by

$$L \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x + 2y \\ x + y \end{pmatrix}.$$

Find the standard matrix A representing L ; $A = (L(e_1), L(e_2))$.

Problem 2:

Determine whether or not the matrices

$$A = \begin{pmatrix} 3 & 2 \\ -1 & 3 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} -1 & -2 \\ 2 & 1 \end{pmatrix}$$

commute with respect to multiplication, that is, whether $AB = BA$ or not.

Problem 3: Find an LU decomposition of the matrix

$$A = \begin{pmatrix} 2 & 0 \\ 1 & 2 \end{pmatrix}.$$

Problem 4: Solve the system

$$10x_1 - x_2 = 25,$$

$$x_1 + 8x_2 = 43,$$

using Jacobi's method, with the initial guess $x^{(0)} = 0$, up to two iterations.