# Proposal for Course Update

## Department of Electrical Engineering

## IIT Kanpur

1. **Course Number**: EE605

2. **Title**: Linear Algebra for Engineering

3. **Proposing Department**: EE

4. **Other Departments**: AE, IS

5. **Proposer**: Ketan Rajawat (EE)

6. **Other interested facult**y: Abhishek Gupta, Tushar Sandhan, Aditya Jagannatham, Rohit Budhiraja, Ajit K. Chaturvedi, and other faculty from SPCOM stream in EE.

7. **Units**: [9]  (3-0-0-0)

8. **Duration of the course**: full semester

9. **Pre-requisites**: N/A

10. **Course description**

    a. **Objectives**: This is an introductory linear algebra course meant primarily for first year PG students in MTech, MS, and PhD programs in EE, but can also be taken by students of other departments. The course seeks to introduce the fundamental concepts in applied linear algebra, primarily from an applied perspective. The course is designed to serve as a foundation for advanced courses in the areas of signal processing, communications, machine learning, autonomous systems, and numerical methods.

    b. **Contents**:

| Sr. No. | Broad Title | Topics | No. of Hours |
|---|---|---|---|
| 1. | Introduction and Preliminaries | 1. Vectors and vector operations<br>2. Inner Product<br>3. Norms<br>4. Vector Spaces | 6 |

| | | 5. Matrices | |
| | | 6. Transpose | |
| | | 7. Block Matrices | |
| 2 | Linear Systems | 1. Systems of Linear Equations<br>2. Inverse, Least Squares | 2 |
| 3. | Decompositions | 1. LU Decomposition<br>2. QR Decomposition | 3 |
| 4. | SVD | 1. SVD Overview<br>2. Null space, column space<br>3. Rank-r approximation | 8 |
| 5. | Systems of Equations | 1. Projection<br>2. Linear independence<br>3. Span, Basis<br>4. Solving Ax=b | 8 |
| 6. | Determinants | 1. Linear Transformation<br>2. Permutations & Cofactors<br>3. Determinants | 6 |
| 7. | Eigenvalue Decomposition | 1. Eigenvalues and Eigenvectors<br>2. Diagonalization<br>3. Markov Matrices<br>4. Positive Definite Matrices<br>5. Complex Matrices | 6 |

**11. Short summary for the course booklet**: This course covers topics including vectors, matrices, decompositions (LU, QR, SVD), vector spaces, linear transformations, eigenvalues, and matrix calculus.

**12. References**:

1. Strang, Gilbert. Linear algebra for everyone. Wellesley, MA, USA: Wellesley-Cambridge Press, 2020.
2. Boyd, Stephen, and Lieven Vandenberghe. Introduction to applied linear algebra: vectors, matrices, and least squares. Cambridge university press, 2018.
3. Sheldon Axler, "Linear algebra done right" Springer Nature, 2024

**Other Comments:** This is a compulsory course for first year MTech students in the SPCOM stream of EE

Convener, DPGC                                                                                    Chairperson, SPGC