Linear Algebra - Video course

COURSE OUTLINE

Systems of linear equations, Matrices, Elementary row operations, Row-reduced echelon matrices. Vector spaces, Subspaces, Bases and dimension, Ordered bases and coordinates.

Linear transformations, Rank-nullity theorem, Algebra of linear transformations, Isomorphism, Matrix representation, Linear functionals, Annihilator, Double dual, Transpose of a linear transformation.

Characteristic values and characteristic vectors of linear transformations, Diagonalizability, Minimal polynomial of a linear transformation, Cayley-Hamilton theorem, Invariant subspaces, Direct-sum decompositions, Invariant direct sums, The primary decomposition theorem, Cyclic subspaces and annihilators, Cyclic decomposition, Rational, Jordan forms.

Inner product spaces, Orthonormal bases, Gram-Schmidt process.

COURSE DETAIL

Lectures	Topic
1	Introduction to the Course Contents.
2	Linear Equations
3a	Equivalent Systems of Linear Equations I: Inverses of Elementary Row-operations, Row-equivalent matrices
3b	Equivalent Systems of Linear Equations II: Homogeneous Equations, Examples
4	Row-reduced Echelon Matrices
5	Row-reduced Echelon Matrices and Non-homogeneous Equations

NP-TEL

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http://nptel.ac.in

Mathematics

Additional Reading:

1. S. Axler, Linear Algebra Done Right, 2nd Edition, John-Wiley, 1999.
2. S. Lang, Linear Algebra, Springer UTM, 1997.
3. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India, 2004.

Coordinators:

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6	Elementary Matrices, Homogeneous Equations and Non-homogeneous Equations	
7	Invertible matrices, Homogeneous Equations Non-homogeneous Equations	
8	Vector spaces	
9	Elementary Properties in Vector Spaces. Subspaces	
10	Subspaces (continued), Spanning Sets, Linear Independence, Dependence	
11	Basis for a vector space	
12	Dimension of a vector space	
13	Dimensions of Sums of Subspaces	
14	Linear Transformations	
15	The Null Space and the Range Space of a Linear Transformation	
16	The Rank-Nullity-Dimension Theorem. Isomorphisms Between Vector Spaces	
17	Isomorphic Vector Spaces, Equality of the Row-rank and the Column-rank I.	
18	Equality of the Row-rank and the Column-rank II	
19	The Matrix of a Linear Transformation	
20	Matrix for the Composition and the Inverse. Similarity Transformation	
21	Linear Functionals. The Dual Space. Dual Basis I	
22	Dual Basis II. Subspace Annihilators I	
23	Subspace Annihilators II	
24	The Double Dual. The Double Annihilator	

25	The Transpose of a Linear Transformation. Matrices of a Linear Transformation and its Transpose
26	Eigenvalues and Eigenvectors of Linear Operators
27	Diagonalization of Linear Operators. A Characterization
28	The Minimal Polynomial
29	The Cayley-Hamilton Theorem
30	Invariant Subspaces
31	Triangulability, Diagonalization in Terms of the Minimal Polynomial
32	Independent Subspaces and Projection Operators
33	Direct Sum Decompositions and Projection Operators I
34	Direct Sum Decomposition and Projection Operators II
35	The Primary Decomposition Theorem and Jordan Decomposition
36	Cyclic Subspaces and Annihilators
37	The Cyclic Decomposition Theorem I
38	The Cyclic Decomposition Theorem II. The Rational Form
39	Inner Product Spaces
40	Norms on Vector spaces. The Gram-Schmidt Procedure I
41	The Gram-Schmidt Procedure II. The QR Decomposition
42	Bessel's Inequality, Parseval's Indentity, Best Approximation
43	Best Approximation: Least Squares Solutions
44	Orthogonal Complementary Subspaces, Orthogonal

44	Projections
45	Projection Theorem. Linear Functionals
46	The Adjoint Operator
47	Properties of the Adjoint Operation. Inner Product Space Isomorphism
48	Unitary Operators
49	Unitary operators II. Self-Adjoint Operators I
50	Self-Adjoint Operators II - Spectral Theorem
51	Normal Operators - Spectral Theorem

References:

1. K.Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice- Hall of India, 2005.

2. M. Artin, Algebra, Prentice-Hall of India, 2005.