

## CSDC1-201: Linear Algebra for Computer Science

### **Determinants** 3L

Determinants, Cofactors, Evaluation and properties of determinants

[1]: [chap 4: 4.1 - 4.4]

### **Matrices & System of Linear Equations** 10 L

Introduction, Matrix Algebra, Transpose of a Matrix, Elementary row operations on a Matrix, Echelon form of a Matrix, Rank of a Matrix, Inverse of a matrix, Solution of System of Homogeneous & Non-Homogeneous Equations: Gauss elimination, Cramer's rule. Numerical Methods: Gauss Jordan, Jacobi and Gauss Sidel Methods.

[1]: [chap 1: 1.1 - 1.6, ch2: 2.2]

[2]: [chap 1: 1.2, 1.6]

### **Vector Spaces** 7L

Definition of a Vector Space, Sub-spaces, Linear Combinations, Linear Span, Convex Sets, Linear Independence/Dependence, Basis & Dimension, Application to Graphs and Networks

[1]: [chap 2: 2.1, 2.3, 2.4, 2.5]

[2]: [chap 2: 2.1-2.6]

### **Linear Transformation** 7 L

Linear transformation on finite dimensional vector spaces, Kernel & Image of a Linear transformation, Matrix and coordinates of a Linear transformation with respect to an ordered basis, Similar matrices.

[1]: [chap 2: 2.6]

[2]: [chap 3.1-3.4, 3.7]

### Inner Product Spaces

6 L

Inner Product, Definition& examples, Parallelogram Law, Schwarz Inequality, Gram-Schmidt Orthogonalization Process, Orthonormal Basis

[1]: [chap 3: 3.1 - 3.4]

[2]: [chap 8: 8.1, 8.2]]

### Eigen Values & Eigen Vectors of linear transformations and matrices 7L

Definition of Eigen Value and Eigen Vector, Characteristic Polynomial, Eigen spaces, Diagonalization, Cayley Hamilton Theorem, Applications to Markov Matrices and Economic Models.

[1]: [chap 5: 5.1 - 5.3]

[2]: [chap 6: 6.1, 6.2]]

### Positive Definite Matrices

3L

Positive Definite Matrices, Singular Value Decomposition.

[1]: [chap 6: 6.1 - 6.3]

### Applications to Linear Programming

5L

LU Factorization, Linear Inequalities, Feasible Set and the cost function, Graphical Method, Simplex Method -.

[1]: [chap 8: 8.1, 8.2]

### Recommended Reading Material

#### Text Books

1. Gilbert Strang, Wellesey, *Introduction to Linear Algebra*, Fourth Edition, , Cambridge Press/Cengage Learning,2009
2. K Hoffman& R Kunze, *Linear Algebra* 2/e, PHI, 2000

## Reference Books

1. I N Herstein: Topics in Algebra, 2<sup>nd</sup> Edition, John Wiley and son ,2006

## Online Reading/Supporting Material

3. MIT Open Courseware Linear Algebra by Gilbert Strang:  
<http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index.htm>

## LIST OF PRACTICALS BASED ON CSDC1-201 :LINEAR ALGEBRA FOR COMPUTER SCIENCE

S. No.	Practical Title
1.	Create and transform vectors and matrices (the <i>transpose</i> vector (matrix)& <i>conjugate transpose</i> of a vector (matrix))
2.	Solve system of Homogeneous and non homogeneous equations using Gauss elimination, Cramer's rule.
3.	Generate the matrix into echelon form and find its rank .
4.	Generate the LU decomposition of a matrix. Find cofactors, determinant, adjoint and inverse of a matrix
5.	Generate basis of column space, null space, row space and left null space of a matrix space
6.	<b>Solution of system of equations using numerical methods</b>
7.	Check the linear dependency of vectors . Generate a linear combination of given vectors of $R^n$ / matrices of same size and find the transition matrix of given matrix space
8	Find the orthonormal basis of a given vector space using Gram-Schmidt orthogonalization process

## FOUR YEAR UNDERGRADUATE PROGRAMME IN COMPUTER SCIENCE

9.	Check the diagonalizable property of matrices and find the corresponding eigen value and verify the Cayley- Hamilton theorem
10.	Problems on LU factorization
11.	Application of Linear algebra: Coding and decoding of messages using non singular matrices. eg <b><u>code “Linear Algebra is a fun” and then decode it</u></b>
12.	Solve Linear programming problem (graphical and simplex method )

**Software to be used : MATLAB/ MATHEMATICA etc.**