

NIRMA UNIVERSITY
Institute of Technology
M Tech Computer Science and Engineering
Semester – I

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Course Code	6CS205
Course Name	Applied Mathematics for Computer Science

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. comprehend the mathematical fundamentals related to sets, probability, statistics, linear algebra and mathematical optimization
2. apply the mathematical principles to solve wide range of problems in computer science
3. use the mathematical concepts as per the need of the application

Syllabus:

Teaching Hours

Unit I

Review of Linear Algebra: Matrices, Vectors properties, Eigenvalues and eigenvectors, Matrix factorizations, Distance measures, Projections, Notion of hyperplanes, Half-planes, Application for Linear Algebra in Computer Science

8

Unit II

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate), Expectations and moments, Covariance and correlation, Confidence intervals, Correlation functions, Random walks, Markov chains, Statistical inference, Applications in Regression and Classifications.

16

Unit III

Optimization: Basic Concepts, Linear Programming, Duality, Constrained and unconstrained optimization, gradient decent and non-gradient techniques, Introduction to least squares optimization, optimization in Practice.

12

Unit IV

Advanced topics: Nonlinear dimensionality reduction methods, PCA in high dimensions and random matrix theory (Marcenko-Pastur), Linear Discriminant Analysis, Non-Negative Matrix Factorization, Hypothesis testing, Proof Techniques, Random Graphs

9

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings^:

1. Gilbert Strang, Introduction to Linear Algebra, Cambridge Press.
2. Gilbert Strang, Linear Algebra and its applications, Harcourt, Brace, Jovanovich Publishers
3. Douglas C. Montgomery, George C. Runger, Applied Probability and Statistics for Engineers, Wiley



4. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press
5. Sheldon Ross, A first course in Probability, Pearson
6. Cathy O’Neil and Rachel Schutt, Doing Data Science, O’Reilly Media
7. Avrim Blum, John Hopcroft, and RavindranKannan, Foundations of Data Science, e-book, Cornell University
8. Afonso S. Bandeira, Ten Lectures and Forty-Two Open Problems in the Mathematics of Data Science, e-book, MIT OCW
9. Jeff M. Phillips, Mathematical Foundations for Data Analysis, e-book, University of Utah
10. O. Panerselvam, Operational Research, PHI

L=Lecture, T=Tutorial, P=Practical, C=Credit

^this is not an exhaustive list

A handwritten signature in black ink, appearing to be 'John', with a horizontal line extending to the right from the end of the signature.