RAMAKRISHNA MISSION VIDYAMANDIRA

NEP Syllabus B.Sc. Computer Science Honours

Semester-V

Course Code: 5CMSMJC1

Course Type: Major Course

Course Outcome:

- Recall the foundational math facts and definition like operations on matrices, vectors, derivatives, integrals, theorems on the probability, conditional probability.
- Understand the formulation of optimization problems and identify convexity.
- Apply linear algebra techniques (including PCA) in solving ML-relevant problems.
- Analyze statistical inference problems including sampling, estimation, and hypothesis testing.
- Evaluate expectation and variances of discrete and continuous distributions.
- Formulate and solve linear and nonlinear programming problems using appropriate methods.

5CMSMJC1: Mathematics for Machine Learning

Credit: 3 **Marks: 50**

Introduction to Linear Algebra: Operations on vectors, Matrices and systems of linear equations, Vector spaces, Subspaces, Basis and Dimension, Linear transformations, Change of Basis, Orthogonal Complement and Projection Mapping, Eigenvalues and Eigenvectors, LU decomposition, QR decomposition, and Singular Value Decomposition (SVD), Low Rank Approximations, Least squares approximation and minimum normed solutions, Principal Component Analysis. **[16L]**

Calculus: Differentiation and Integration- Understanding the fundamental concepts of calculus, Multivariate Calculus, Partial Derivatives, Jacobian and Hessian Matrices and their role in optimization. **[7L]**

Probability and Statistics: Review on Probability, Bayes' Theorem, Discrete and continuous random variables, Probability Mass Function and Probability Density Function, Cumulative

Distribution Function and its properties, Expectation, Variance, Standard Deviation, Discrete distributions (Binomial, Poisson, Geometric), Continuous distributions (Normal, Exponential) and their properties, Introduction to Markov Chain, Sampling methods, Statistical inferences (Estimation, Hypothesis Testing), Maximum likelihood estimation in Binomial, Multinomial, Gaussian models. **[15L]**

Convex Optimization for Machine Learning: Introduction to Optimization Problems, Convex sets and functions, Linear and Non-Linear Programming problem formulation and solution. **[7L]**

5CMSMJC1: Mathematics for Machine Learning Tutorial

Credit: 1 **Marks: 25**

Some practical problems incorporating the application power and knowledge on linear transformations, decomposition, least squares problem solving, PCA, maximum likelihood estimations, Linear and Non-Linear Programming problem formulation and solution.

Books and references:-

1. Introduction to Machine Learning, by Jeeva Jose, Khanna Book Publishing.
2. Linear Algebra and Learning from Data by Gilbert Strang, Wellesley Cambridge Press.
3. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, MIT Press.
4. Mathematics for machine learning by Deisenroth MP, Faisal AA, Ong CS, Cambridge University press.
5. Matrix Differential Calculus with Applications in Statistics and Econometrics by Jan R. Magnus and Heinz Neudecker, Wiley Series in Probability and Statistics.
