MATHEMATICS FOR MACHINE LEARNING

(Effective from the academic year 2018 -2019)

SEMESTER – V

Subject Code	18AI56	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Improve the skills and knowledge in linear algebra to get more out of machine learning.
- Understand the vector calculus required to build many common machine learning techniques.
- Learn the probability and distribution in statistics to build machine learning applications.
- Learn the basic theoretical properties of optimization problems, for applications in machine learning

Module – 1	**CH**
Linear Algebra-Part1: Introduction,Matrices , System of Linear Equations, Vector Spaces, Linear Dependence and Independence, Gaussian Elimination, Basis and Basis Set, Rank, Norms , Inner Products, Lengths and Distances, Angles (**Ch: 2-2.6, Ch:3-3.3**) **RBT: L1, L2**	08
Module – 2	
Linear Algebra-Part2: Orthogonality, Orthonormal Basis, Orthogonal Complement, Rotations, Determinant and Trace, Eigenvalues and Eigenvectors – its interpretations, Projections, Regression, Diagonalization, Singular Value Decomposition(**Ch:3.4-3.6, 3.9, Ch:4-4.5**) **RBT: L1, L2**	08
Module – 3	
Vector Calculus: Introduction, Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation (**Ch-5**) **RBT: L1, L2**	08
Module – 4	
Probability and Distributions, Probability, Conditional Probability, Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform, Discrete and Continuous Random Variables and Distributions, Expectation and its Interpretations, Standard discrete and continuous distribution functions, Central Limit theorem (**Ch-6**) **RBT: L1, L2**	08
Module – 5	
Optimization: Introduction, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization (**Ch-7**) **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Improve the skills and knowledge in linear algebra to get more out of machine learning.
- Understand the vector calculus required to build many common machine learning techniques.
- Learn the probability and distribution in statistics to build machine learning applications.
- Learn the basic theoretical properties of optimization problems, for applications in machine learning

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. "Mathematics for Machine Learning" , Published by Cambridge University Press, Copyright 2020

Reference Books:

Textbooks:

1. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014

Reference Books:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. StaurtRussel, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3rd Edition, 2009
4. George F Luger, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

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