Course No.:	**Name:** Mathematical Foundations for Cloud Computing	**Credits:** 3-0-0-6	**Prerequisites:** YES

COURSE OBJECTIVES:

1. Develop an understanding of probability theory, random variables, and processes that are relevant to cloud computing.
2. Understand the mathematical concepts that underlie cloud computing systems.
3. Learn linear algebra and optimization theory and their application in cloud computing systems.
4. Acquire practical skills to apply mathematical concepts in the design and evaluation of cloud computing systems.

COURSE OUTCOMES:

1. Explain the concepts of probability theory, random variables, and processes in cloud computing systems.
2. Apply linear algebra techniques to solve problems related to cloud computing.
3. Apply optimization techniques to formulate and solve problems in cloud computing systems.
4. Evaluate and design cloud computing systems using mathematical concepts learned in the course.

Prerequisites:

1. Basic understanding of computer science and mathematics
2. Familiarity with calculus and linear algebra

Module 1: Introduction to Cloud Computing and Mathematical Foundations (6 hours)

- Introduction to Cloud Computing
- Overview of Mathematical Foundations: Probability theory, Linear Algebra, Optimization Theory

Module 2: Probability Theory and Random Variables for Cloud Computing Systems (18 hours)

- Review of Probability Theory
- Random Variables and Processes for Cloud Computing Systems
- Density Functions and Distribution
- Mean, Variance and Higher Order Moments
- Common Discrete Distributions
- Common Continuous Distributions
- Multivariate Distributions
- Law of Large Numbers (LLN)
- Central Limit Theorem (CLT)

Module 3: Linear Algebra for Cloud Computing Systems (9 hours)

- Vectors and Matrices
- Matrix Operations
- Definition of Eigenvalue and Eigenvector
- Inner Product and Orthogonal Basis

Module 4: Optimization Theory and Its Application for Cloud Computing Systems (12 hours)

- Basics of Optimization Theory
- Classes of Optimization Problems (Linear, Nonlinear, Continuous, Constrained, Unconstrained, Single-Multiple Variables)
- Convex Functions and Its Properties
- Convex Optimization Problem
- Algorithms for Convex Optimization (Steepest Descent and Newton's)

Text/Reference Book:

1. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables, and Stochastic Processes, Tata McGraw-Hill (2002).
2. Alberto Leon-Garcia, Probability and Random Processes for Electrical Engineering, Pearson Education India (1994).
3. Stephen Boyd, Stephen P. Boyd, and Lieven Vandenberghe, Convex Optimization,
4. Cambridge University Press (2004).
5. Suresh Chandra, Jayadeva, and Aparna Mehra, Numerical Optimization with Applications, Alpha Science International (2009).