Programme: MCA
Course code: CSC-203 **Title of course:** Mathematics for Computer Science
Number of credits: 4 (4L-0T-0P) **Total contact hours:** 48 hours (48L-0T-0P)
Effective from AY: 2021-22

Prerequisites for the course	Program Prerequisites	
Objectives	Students will be able to: Apply the concepts of mathematics in the modeling and design of computational problems and deeper understanding of subjects like machine learning/deep learning and other computer science subjects.	
Content	Introduction – importance of mathematics and their applications for computer science/machine learning/data science/deep learning *Functions, variables, equations, graphs* revision **Probability and Statistics:** Probability Rules & Axioms, Bayes' Theorem, Random Variables, Variance and Expectation, Conditional and Joint Distributions, Standard Distributions (Bernoulli, Binomial, Multinomial, Uniform and Gaussian), Moment Generating Functions, Maximum Likelihood Estimation (MLE), Prior and Posterior, Maximum a Posteriori Estimation (MAP) and Sampling Methods-confidence intervals, Hypothesis testing, p-values, A/B testing-ANOVA, t-test-Linear regression, regularization **Calculus** Overview of Differential and Integral Calculus, Partial Derivatives Product and chain rule-Taylor's series, infinite series summation/integration concepts-Fundamental and mean value-theorems of integral calculus, evaluation of definite and improper integrals-Beta and Gamma functions, Functions of multiple variables, limit, continuity, partial derivatives-Basics of ordinary and partial differential equations -Applications of Calculus	2 hrs 7 hrs 7L

	Linear Algebra: Systems of Linear Equations-Matrices-Solving Systems of Linear Equations-Vector Spaces-Linear Independence-Basis and Rank-Linear Mappings Affine Spaces **Analytic Geometry** Norms-Inner Products-Lengths and Distances Angles and Orthogonality-Orthonormal Basis Orthogonal Complement-Inner Product of Functions-Orthogonal Projections-Rotations **Matrix Decompositions** Determinant and Trace-Eigenvalues and Eigenvectors-Cholesky Decomposition Eigendecomposition and Diagonalization Singular Value Decomposition-Matrix Approximation. **Vector Calculus** Differentiation of Univariate Functions-Partial Differentiation and Gradients-Gradients of Vector-Valued Functions-Gradients of Matrices Useful Identities for ComputingGradients-Backpropagation and Automatic Differentiation-Higher-Order Derivatives-Linearization and Multivariate Taylor Series **Optimization** Primal Solutions and Concept and Need for Duality; Optimization Using Gradient Descent-Constrained Optimization -Lagrange Multipliers-Convex Optimization,	7L 7L 6L 7L 5L
Pedagogy	Problem solving approach and carrying out small project work using matlab tools	
References/ Readings	1. Statistics -Robert S. Witte and John S. Witte 2. Barron's AP Statistics, 8th Edition -Martin Sternstein, PhD. 3. Statistics for Business and Economics - James T. McClave, P. George Benson and Terry T Sincich 4. Naked Statistics: Stripping the Dread from	

	the Data – Charles Wheelan 5. Introduction to Linear Algebra - Gilbert Strang 6. Linear Algebra and Its Applications - David C. Lay 7. Functions and Graphs - I M Gelfand 8. Cartoon guide to calculus – Larry Gonick 9. Optimization Methods in Business Analytics—edX, MIT	
Learning Outcomes	1. To build a strong foundation in maths required for learning computer science/data science subjects. 2.To understand fundamental concepts and tools in calculus and linear algebra with emphasis on their applications to computer science in particular to data science/machine learning	