

Name of the Programme: M.Sc. in Artificial Intelligence

Course Code: CSI-504

Title of course: Mathematics foundation for Artificial Intelligence

Number of credits: 2 (2L-0T-0P)

Effective from AY: 2023-24

<u>Prerequisites for the course</u>	Basic mathematics	
<u>Objectives</u>	To build a strong foundation in maths required for learning computer science/data science subjects. To understand fundamental concepts and tools in calculus, linear algebra etc with emphasis on their applications to computer science in particular data science/machine learning	
<u>Content</u>	Introduction Importance of mathematics and their applications for computer science/machine learning/data science/deep learning Functions, variables, equations, graphs revision	3 hours
	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	7 hours
	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	4 hours
	Linear Algebra: Systems of Linear Equations-Matrices-Solving Systems of Linear Equations-Vector Spaces-Linear Independence-Basis and Rank-Linear Mappings Affine Spaces	3 hours
	Analytic Geometry Norms-(Inner Products-Lengths and Distances Angles and Orthogonality-Orthonormal Basis Orthogonal Complement-Inner Product of Functions-Orthogonal Projections-Rotations) - Eigen value decomposition and SVD	6 hours
	Optimization Differentiation of Univariate Functions-Partial Differentiation and Gradients-Gradients of Vector-Valued Functions-Gradients of Matrices Useful Identities for Computing Gradients-Backpropagation and	7 hours

	Automatic Differentiation-Higher-Order Derivatives-Linearization and Multivariate Taylor Series-Gradient Descent-Constrained Optimization -Lagrange Multipliers-Convex Optimization,	
<u>Pedagogy</u>	Problem solving approach and carrying out small project work using matlab tools	
<u>References/ Readings</u>	1. Statistics Written, Robert S. Witte and John S. Witte 2. Barron's AP Statistics, 8th Edition, Martin Sternstein, PhD. 3. Statistics for Business and Economics by- 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. No bullshit guide to Linear algebra, Ivon Savov 8. Functions and Graphs by I M Gelfand 9. Cartoon guide to calculus, Larry Gonick 10. Optimization Methods in Business Analytics — edX, MIT	
<u>Course Outcomes</u>	1. Strong understanding of mathematical concepts relevant to AI. 2. Application of mathematics in AI problem-solving. 3. Proficiency in quantitative analysis and data interpretation. 4. Development of algorithmic thinking skills for AI algorithms.	