B.TECH.I YEAR (4YDC) COMMON FOR ALL BRANCHES
MA 10021: MATHEMATICS FOR ENGINEERS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
L	T	P	L	T	P	THEORY		PRACTICAL		TOTAL MARKS
						CW	Th.	SW	Pr.	
2	1	0	2	1	0	30	70	--	--	100

PRE-REQUISITE : NIL

COURSE OBJECTIVES

The objective of this course is to develop studentôs analytical and problem-solving skills through foundational concepts of differential and integral calculus, matrices, differential equations, and fuzzy logic, enabling effective application in engineering and scientific domains.

COURSE OUTCOMES

After completing this course student will be able to

CO1: Identify key contributions of Indian mathematicians from ancient to modern era; acquire the knowledge of partial derivatives and its applications in series expansion and finding maxima and minima.

CO2: Evaluate Beta and Gamma functions, solve multiple integrals, and apply change of order and variables using Jacobians for mathematical and engineering problems.

CO3: Analyze and solve matrix-related problems by determining rank, finding inverses, solving linear systems, computing eigenvalues and eigenvectors with applications, and applying the Cayleyï Hamilton theorem to obtain inverses and powers.

CO4: Classify differential equations according to features and solve higher order differential equations, with their applications in relevant domain.

CO5: Differentiate between classical and fuzzy sets, explain and represent membership functions with their properties, perform basic fuzzy set operations, and apply fuzzy set concepts to real-world problems.

COURSE CONTENTS

THEORY

Unit 1 Evolution of Indian Mathematics and Its Contributors:

Ancient Era: Baudhayana **:** Ancient Indian version of the Pythagoras theorem, Aryabhata,VarÜhamihira, **Medieval Era**: Brahmagupta, Bhaskara II, Madhava, **Modern era**: Ramanujan, Shanti Swaroop Bhatnagar, Harish Chandra.

Differential Calculus: Partial derivatives: Definition, Jacobians, Expansion of functions by Taylorôs and Maclaurinôs series of two variables, Maxima and Minima of functions of two variables.

Unit 2 **Integral Calculus:** Beta and Gamma functions, Elementary ideas of multiple integrals, Change of order of integration and change of variables in double integrals using Jacobians.

Unit 3 **Matrices :** Rank of a matrix by Echelon form and Normal form , Inverse of matrices by Gauss- Jordan method, System of linear equations : Solving system of Homogeneous and Non- Homogeneous linear equations, Eigen values, Eigen vectors with their properties and applications, Cayley-Hamilton theorem : Finding inverse and power of a matrix by Cayley Hamilton Theorem.

Unit 4 **Ordinary Differential Equations:** Ordinary Differential Equations: Linear differential equations with constant coefficients, Second order linear differential equations with variable coefficients, Method of variation of parameters, Application to simple problems.

Unit 5 **Fuzzy Sets:** Introduction to Fuzzy Sets, Classical sets vs Fuzzy sets, Crisp set characteristics: Membership Functions, Definition and representation, Types of membership functions, Properties of membership functions: Normality Convexity Support, Operations on Fuzzy Sets: Union, Intersection, and Complement, Applications of Fuzzy Sets.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.
2. H. K. Das, Advanced Engineering Mathematics, S. Chand and Company Ltd., New-Delhi, 2009.

REFERENCE BOOKS

1. Paras Ram, Engineering Mathematics through Applications, CBS Publishers & Distributors Pvt. Ltd., Delhi, 2011.
2. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI Learning Private Limited, 2009.
3. P. Singh, A Brief History of Mathematics in India. New Delhi, India: Hindustan Book Agency, 2010.

B.TECH.I YEAR (4YDC) COMMON FOR ALL BRANCHES

MA 10509: MATHEMATICS FOR DATA SCIENCE

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
L	T	P	L	T	P	THEORY		PRACTICAL		TOTAL MARKS
						CW	Th.	SW	Pr.	
2	1	0	2	1	0	30	70	--	--	100

PRE-REQUISITE : NIL

COURSE OBJECTIVES

This course focuses on the applicability of preliminary mathematical, statistical, and modelling techniques aims to provide students with the know-how and usage of data science to be aligned with the current industry needs.

COURSE OUTCOMES

After completing this course student will be able to

- **CO1:** Analyze the contributions of Indians to the evolution of Statistics and Data Science and their relevance today and Compute and interpret measures of central tendency and dispersion to summarize and describe datasets effectively.
- **CO2:** Apply probability concepts and theorems to analyze events and solve problems using Binomial, Poisson, and Normal distributions.
- **CO3:** Analyze discrete and continuous random variables using PMF, PDF, CDF, and compute their expectation and variance for statistical modeling.
- **CO4:** Apply sampling methods and parametric hypothesis tests to draw inferences about populations, and analyze relationships between variables using correlation and regression techniques.
- **CO5:** Utilize data science tools such as MS-Excel, R, and MATLAB for statistical computing, and analyze case studies to demonstrate practical applications.

COURSE CONTENTS

THEORY

Unit 1 **Contribution of Indians in Development of Statistics and Data Science:** Key contributions and their relevance to Data Science, Ancient Foundations, Colonial and Pre-Independence Period, Post-Independence Growth, Computational and Modern Era.
Introductory Statistics: Measures of Central Tendency ï Mean, Mode and Median, Measures of Dispersion - Range, Quartile, Mean Absolute Deviation, Mean Squared Deviation and Standard Deviation.

Unit 2 **Probability Theory and Probability Distributions:** Mathematical and Classical definitions of probability, Composition of events (Union, Intersection and Complement), Addition theorem of probability, Conditional probability, Multiplication theorem of probability, Bayesô Theorem. Probabilistic Distributions ï Binomial, Poisson, and Normal Distributions.

Unit 3 **Random Variables:** Discrete random variables and Continuous random variables, Probability Mass Function, Probability Density Function, Cumulative Distribution Function, Mathematical Expectation or mean of random variable, variance of random variables.

Unit 4 **Inferential Statistics and Correlation & Regression:** Population and sample, parameter and statistics, Sampling: Methods of sampling (random, stratified, systematic, cluster), Hypothesis testing: Null and Alternative hypotheses, Type-I and Type-II errors, level of significance, parametric tests (t-test, z-test, F-test). **Correlation and Regression:** Karl Pearson and Spearman Rank Correlation coefficient, Regression: Types of Regression Models, Simple Linear Regression.

Unit 5 **Data Science Tools and Case Studies:** Introduction to data tools, MS-Excel for data analysis, R-Programming for statistical computing, MATLAB tools for engineering applications; and Case studies.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. Veerarajan T, Statistics, Probability and Random Process, 2nd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi 2003.
2. H. K. Das, Advanced Engineering Mathematics, S. Chand and Company Ltd., New-Delhi, 2009.

REFERENCE BOOKS

1. Saltz, J.S., and Stanton, J.M., (2018), An Introduction to Data Science, Sage Publications (California, US).
2. M. Ray, H. S. Sharma and S Chaudhary, Mathematical Statistics, Ram Prasad and Sons, Agra, 2004.
3. Ramakalyani Venkatraman and Sita Sundar Ram, History and Development of Mathematics in India, D.K. Printworld Pvt. Ltd., National Mission for Manuscripts, 2022.