BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
COURSE HANDOUT
WORK INTEGRATED LEARNING PROGRAMMES

Part A: Content Design

Course Title	Zero Level Mathematical Foundations
Course No(s)	AIML_MFML
Credit Units	**NO CREDITS; This is an audit course**
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Version No	1.0
Minor Edits	

Course Description

The goal of the course is to strengthen students' foundation in basic mathematical concepts such as matrices, vectors, calculus, and linear systems. This will help them gain the necessary background for understanding advanced topics in data science, machine learning, AI, and engineering.

Course Objectives

No	Objective
CO1	Introduce students to the foundational concepts in matrices, vectors, and algebra.
CO2	Enable students to apply elementary row operations, matrix properties, and solve linear systems.
CO3	Familiarize students with the fundamentals of calculus including continuity, differentiation, and optimization techniques.
CO4	Provide a basic understanding of linear programming and its graphical solution.

Textbook(s)/Reference(s):

No	Author(s), Title, Edition, Publishing House
T1	Thomas and Finney – Calculus and Analytic Geometry, 9th Edition, Pearson Education.
T2	Gilbert Strang – Introduction to Linear Algebra, 5th Edition, Wellesley-Cambridge Press.
R1	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers.
R2	S.C. Malik and Savita Arora – Mathematical Analysis, New Age International Publishers.

Part B: Modular Content Structure

Session	Topics	Reference
	Sunday, July 13, 2025, (4 Hours)	
1	**Matrices and Vectors**	**Class Notes, T2, R1**
	Definition and types of matrices Vectors and their representation Algebra of matrices (addition, subtraction, scalar multiplication) Matrix multiplication Transpose of a matrix	
2	**Elementary Row Operations and Rank**	**Class Notes, T2, R1**
	Elementary row operations Echelon form and reduced echelon form Rank of a matrix	
3	**Determinants and Inverse**	**Class Notes, T2, R1**
	Minors and cofactors Determinants of 2x2 and 3x3 matrices Properties of determinants Inverse of a matrix using adjoint and determinant	
4	**Systems of Linear Equations**	**Class Notes, T2, R1**
	Solving linear systems using matrix methods Gauss elimination and Gauss-Jordan methods Consistency of systems Linear dependence and independence	
5	**Vector Algebra**	**Class Notes, T2, R1**
	Dot product and cross product Projection of one vector on another	

Sunday, July 20, 2025, (2 Hours)		
6	**Calculus - Continuity and Differentiation**	**Class Notes, T1, R2**
	Concept of limits and continuity Definition of differentiability Rules of differentiation Higher order derivatives	

7	**Applications of Derivatives**	**Class Notes, T1, R2**
	Rate of change Maxima and minima Increasing and decreasing functions Applications in real-life problems	
8	**Linear Programming**	**Class Notes, T1, R1 R2**
	Formulation of LPP Graphical method Feasible and infeasible regions Optimal solution	

Additional Reading

- **Paul Dawkins** – *Linear Algebra* (Lamar University Online Notes)
  https://tutorial.math.lamar.edu/
- **Schaum's Outline of Linear Algebra** – *S. Lipschutz and M. Lipson*, McGraw-Hill
  https://www.mheducation.com/highered/product/schaum-s-outline-linear-algebra-lipschutz-lipson/M9780071794565.html
- **MIT OpenCourseWare** – *Calculus and Linear Algebra Lectures*
  https://ocw.mit.edu

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