Syllabus template

Semester: 6	
Programme : Mathematics	
Course : Algebra-2 & Analysis-2	
Paper code: B3MT230611T	**Credits:4**
Hours/week : 4	
Category: Core/MDC/SEC/VAC : Minor	
Theory / Practical / Composite : Theory	
No of Modules : Nil	

Course Overview: Algebra-2 & Analysis-2

This course advances matrix algebra, introductory abstract algebra, and real analysis. In matrices & determinants, students master trace, symmetric/skew-symmetric/orthogonal/unitary/Hermitian matrices, Laplace expansion, row operations, rank, inverses, and solve linear systems via matrix methods and Cramer's rule. Group theory introduces binary operations, groups (finite/infinite examples), subgroups with necessary/sufficient conditions, plus elementary ring/field concepts as vector space prerequisites. Analysis covers continuity (at points/intervals, discontinuity types, properties on closed intervals), derivatives (one-sided, monotonicity, Leibnitz theorem), and improper integrals (μ-test, comparison test, Beta/Gamma functions). Emphasis is on problem-solving across pure mathematics topics.

Course Outcome: On successful completion of the course a student will be able to do the following:

1. **Identify** properties of matrices (trace, symmetric/orthogonal/Hermitian) and determinants (Laplace expansion, adjoints).
2. **Compute** matrix rank, inverses via row operations, and solve linear systems using Cramer's rule/matrix methods.
3. **Verify** group axioms, subgroup conditions, and elementary ring/field properties with examples.
4. **Classify** types of discontinuities and analyze continuity on closed intervals.
5. **Derive** one-sided derivatives, apply Leibnitz theorem, and determine monotonicity from derivatives.
6. **Evaluate** improper integrals using μ/comparison tests and Beta/Gamma functions.
7. **Prove** key theorems on matrix properties, group structures, and continuity/derivatives.

Prerequisites:

SYLLABUS

UNIT/Module	CONTENT	NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I. Algebra-2	Matrices & Determinants: Trace of a square matrix –its basic results, Symmetric and skew-symmetric matrices, Orthogonal, Unitary & Hermitian matrices, their properties and related problems.	**30**	**CO1, CO2, CO3, CO4**	**K1, K2, K3, K4**

	Product of two determinants, Adjoint, Symmetric and skew-symmetric determinants & their properties. Laplace's expansion method for fourth-order determinants. Elementary Row Operations on a matrix, Row Echelon form, rank of a matrix, finding inverse of a matrix using elementary row operations. Consistency and solution of a system of linear equations with not more than three variables by matrix method, Cramer's rule Introduction to Group Theory: Binary operations, commutativity, associativity, existence of identity and inverse elements, examples. Definition of group, examples of infinite and finite groups. Elementary properties of groups and related problems. Definition & examples of a subgroup, statement of necessary and sufficient conditions of being a subgroup, and its applications. Elementary ideas of Ring & Field as prerequisites to Vector space.			
II. Analysis-2	Continuity of real-valued functions: Continuity of a function at a point and in an interval, Different kinds of discontinuities. Acquaintance (no proof) with the important properties of continuous functions on closed and bounded intervals, Statement of existence of	**22**	**CO5, CO6, CO7**	**K3, K4, K5, K6**

	inverse function of a strictly monotone function and its continuity. Derivative: LHD & RHD, Sign of derivative, monotone increasing and decreasing functions, Relations between continuity and derivability, Successive derivatives, Statement of Leibnitz Theorem and its applications. Improper integrals: Definition, statement of μ-test and comparison tests-simple applications only. Use of Beta and Gamma functions (convergence and useful relations being assumed).			

Text Books
1. Mathematical Analysis: Malik & Arora.
2. Classical Algebra: S.K.Mapa
3. Higher Algebra: Abstract and Linear: S.K. Mapa.
4. An Introduction to Analysis (Differential Calculus (Part-1)): Maity & Ghosh.
Suggested readings
1. Introduction to Real Analysis: Bartle & Sherbert.
2. Calculus (Vol-1): T.M.Apostol
Web Resources
Evaluation: Theory CIA: 20+5+5=**30** Semester Exam: **70**
Paper Structure for Theory Semester Exam Module: 7 questions each of 10 marks out of a set of **12/13** questions.

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	**Identify** properties of matrices (trace, symmetric/orthogonal/Hermitian) and determinants (Laplace expansion, adjoints).	**K1, K2**
CO2	**Compute** matrix rank, inverses via row operations, and solve linear systems using Cramer's rule/matrix methods.	**K3**
CO3	**Verify** group axioms, subgroup conditions, and elementary ring/field properties with examples.	**K3, K4**

CO4	**Classify** types of discontinuities and analyze continuity on closed intervals.	**K4**
CO5	**Derive** one-sided derivatives, apply Leibnitz theorem, and determine monotonicity from derivatives.	**K3, K4**
CO6	**Evaluate** improper integrals using μ/comparison tests and Beta/Gamma functions.	**K5**
CO7	**Prove** key theorems on matrix properties, group structures, and continuity/derivatives.	**K6**