Syllabus template

Semester: I	
Programme : Mathematics	
Course : Algebra-1	
Paper code: C1MT230121T	**Credits: 4**
Hours/week : 4 hours	
Category: Core/MDC/SEC/VAC : Core	
Theory / Practical / Composite : Theory	
No. of Modules : NA	

Course Overview: Algebra -1 introduces students to the fundamental ideas of abstract algebra and linear algebra. The course covers properties of integers, divisibility, congruence relations, and the principle of mathematical induction. It explores relations and functions, followed by the study of algebraic structures such as groups, including cyclic, permutation, and dihedral groups, along with concepts like subgroups, cosets, and Lagrange's theorem. The course also introduces rings and fields. In addition, students learn basic matrix theory, elementary row operations, and methods for solving systems of linear equations, providing a foundation for advanced studies in mathematics and related disciplines.

Course Outcome:

1. Explain the abstract nature of mathematics and recognize the role of abstraction in mathematical reasoning.
2. Describe and analyze the structure and properties of algebraic groups with appropriate examples.
3. Explain the fundamental concepts of matrix theory and examine their relationships with algebraic structures such as groups.
4. Apply the concepts of group theory to interpret basic applications in scientific disciplines such as physics, chemistry, and biology.
5. Illustrate how basic algebraic principles can be used to understand and analyze potential risks in online transactions.
6. Apply fundamental algebraic structures and counting principles to model and analyze patterns such as species counting in ecosystems.

Prerequisites: Students enrolling in this course should have a basic understanding of high school mathematics, including elementary algebra, sets, functions, and systems of linear equations. Familiarity with mathematical reasoning, basic proof techniques, and symbolic manipulation will be helpful. A foundational knowledge of matrices and determinants at the introductory level is also desirable to facilitate the study of abstract algebraic structures and linear algebra concepts covered in the course.

SYLLABUS:

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Well-ordering property of positive integers (statement), division algorithm, divisibility and Euclidean algorithm (proofs required) (3). Congruence	**7 hours**	**CO1, CO2**	**K2,K3**

	relation between integers (2) Principles of Mathematical induction, Statement of Fundamental Theorem of Arithmetic (2)			
II.	Binary Relations. Equivalence relation and Partition: Their Equivalence (2) Functions: Injective, surjective, bijective. Composition of functions, Invertible functions (3).	**5 hours**	**CO2, CO3,CO5**	**K2, K3**
III.	Definition and Properties of Groups (2) Example and properties of groups of nth roots of unity, Permutation groups, group of residue modulo classes, Dihedral groups, Cyclic groups, group of units modulo n. (10)	**12 hours**	**CO3,CO4**	**K3,K4**
IV.	Introduction to Matrix and determinants: Examples of groups like M(n,R), GL(n,R), symmetric, orthogonal, diagonal etc. (5)	**5 hours**	**CO3**	**K2,K3,K4**
V.	Properties relating to order of an element of a group, order of a group, Subgroups (3), Cosets, Lagrange's Theorem for finite groups (3) Fermat's Little theorem, Definition and examples of Rings and Fields. (2).	**8 hours**	**CO2,CO3**	**K4,K5,K6**
VI.	Systems of linear equations Ax=b: Homogenous and Non-Homogenous systems (3). Elementary Row Operation: row reduction and echelon forms, rank of a matrix (5). Consistency of a system of linear equations (2). Solution set of linear systems: Gauss Elimination method and Matrix Inversion Method. (5)	**15 hours**	**CO3,CO6**	**K3,K5**
Text Books				
1. Abstract Algebra by Dummit and Foote.				

2. Topics in Algebra by I.N. Herstein.
3. Linear Algebra by Arnold J. Insel, Lawrence E. Spence, and Stephen H. Friedberg
Suggested readings
1. Contemporary Abstract Algebra by Joseph Gallian.
2. Linear Algebra: A geometric Approach by S. Kumaresan.
3. Linear Algebra by K.Hoffman and R.. Kunz. **Online**
Web Resources
https://archive.nptel.ac.in/courses/111/106/111106113/ **https://archive.nptel.ac.in/courses/111/104/111104137/**
Evaluation : Theory CIA: 20+5+5=30 Semester Exam: 70
Paper Structure for Theory Semester Exam Module : : 7 questions each carrying 10 marks out of 12/13 questions.

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	Explain the abstract nature of mathematics and recognize the role of abstraction in mathematical reasoning.	K2,k3
CO2	Describe and analyze the structure and properties of algebraic groups with appropriate examples.	K2,K3,K4,K5,K6
CO3	Explain the fundamental concepts of matrix theory and examine their relationships with algebraic structures such as groups.	K2,K3,K4,K5,K6
CO4	Apply the concepts of group theory to interpret basic applications in scientific disciplines such as physics, chemistry, and biology.	K3,K4
CO5	Illustrate how basic algebraic principles can be used to understand and analyze potential risks in online transactions.	K2,K3
CO6	Apply fundamental algebraic structures and counting principles to model and analyze patterns such as species counting in ecosystems.	K3,K5