Syllabus template

Semester: 3	
Programme : Mathematics	
Course : Algebra-2	
Paper code: C2MT230321T	**Credits: 4**
Hours/week : 4hrs	
Category: Core/MDC/SEC/VAC : Core	
Theory / Practical / Composite : Theory	
No of Modules : NA	

Course Overview: The course **Algebra-2** introduces fundamental concepts of **Group Theory and Linear Algebra**. It covers homomorphisms, kernels, normal subgroups, quotient groups, and the First, Second, and Third Isomorphism Theorems, along with monomorphism, epimorphism, and cyclic group isomorphisms. The course also develops the theory of **vector spaces**, including subspaces, linear combinations, span, linear independence, basis, and dimension. Further topics include **linear transformations**, null space, range, rank–nullity, matrix representation, and coordinate changes. The course emphasizes understanding algebraic structures, transformations between them, and the classification of groups and vector spaces through isomorphisms.

Course Outcome:

1. **Explain and apply** the construction of new groups from existing groups using group homomorphisms and transformations.
2. **Analyze and classify** groups by studying group transformations and isomorphisms.
3. **Understand and apply** the concepts of abstract vector spaces, subspaces, and their fundamental properties.
4. **Analyze and evaluate** linear transformations, including their properties such as null space, range, rank, and matrix representations.

Prerequisites: ***Basic knowledge about Group Theory and Matrices.***

SYLLABUS

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Homomorphism and Isomorphism of group--definition and examples (3) Homomorphism theorems relating to identity, inverse, image and inverse image of a subgroup, order of an image of an element, Kernel of a homomorphism—related results (5). Normal subgroups, Quotient group - Examples, (3) First Isomorphism theorem. Monomorphism, epimorphism, isomorphism— related results; (3) Infinite cyclic group is isomorphic to (Z,+) and finite	**19hrs**	**CO1,CO2**	**K2,K3**

	cyclic group is isomorphic to(Zn,+), Isomorphism of a group with subgroup and quotient of another groups. Isomorphic classes of groups.(5)			
II.	Natural homomorphism of G onto G/N, N being a normal subgroup of G. Second and Third Isomorphism Theorems, Isomorphism results relating to normal subgroups (5).	**5hrs**	**CO2**	**K4, K2**
III.	Introduction to vector space and its subspaces (4) Algebra of subspaces, quotient spaces (3) linear combination of vectors, linear span, linear independence (3), basis and dimension. Infinite dimensional vector spaces : only examples (3).	**13hrs**	**CO3**	**K2,K3**
IV.	Linear transformations, null space, range, rank and nullity of a linear transformation (4), matrix representation of a linear transformation (2), algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, properties of isomorphism (6) change of coordinate matrix (3).	**15hrs**	**CO4**	**K4,K5**

Text Books

1. **Contemporary Abstract Algebra by Joseph Gallian.**
2. **Abstract Algebra by Dummit and Foote.**
3. **Topics in Algebra by I.N. Herstein**
4. **Linear Algebra by Arnold J. Insel, Lawrence E. Spence, and Stephen H. Friedberg.**
5. **Linear Algebra: A geometric Approach by S. Kumaresan.**
6. **Introduction to linear Algebra by Gilbert Strang.**
7. **Linear Algebra by K.Hoffman R.. Kunz**

Suggested readings

1. **Elementary Linear Algebra by Howard Anton, Chris Rorres.**

2. **Linear Algebra Done Right by Sheldon Axler.**
1. **Abstract Algebra by J.B.Fraleigh.**
Web Resources
1.
2.
3.
4.
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 and apply** the construction of new groups from existing groups using group homomorphisms and transformations.	K2, K3
CO2	**Analyze and classify** groups by studying group transformations and isomorphisms.	K4, K2
CO3	**Understand and apply** the concepts of abstract vector spaces, subspaces, and their fundamental properties.	K2, K3
CO4	**Analyze and evaluate** linear transformations, including their properties such as null space, range, rank, and matrix representations.	K4, K5