ST.JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS) , VISAKHAPATNAM

III SEMESTER **MATHEMATICS** TIME : 5 HRS/WEEK

M 3302(3) **ABSTRACT ALGEBRA** MAX. MARKS : 100

(Group Theory& Ring Theory)

w.e.f. 2021-2022 (AH Batch) **SYLLABUS**

COURSE OBJECTIVES: To enable the students to –

- Understand the concept of binary operations by definition and examples.
- Determine whether a given binary operation on the given set gives a group structure by applying the axioms.
- Determine whether a given group is abelian by checking the properties.
- Describe all elements in a cyclic subgroup by using generators.
- Understand the importance of algebraic properties with regard to working within various number systems
- Compute the expression of permutation groups by using permutation multiplication.
- Understand the ring theory concepts with the help of knowledge in group theory and to prove the theorems.
- Understand the applications of ring theory in various fields

COURSE OUTCOMES: At the end of the course student will :

- **CO1:**Be able to study the properties of sets, and check whether the given set are groups or not and study various theorems which can be applied to study various algebraic structures.
- **CO2:**Be able to understand the concept of equivalence relation by applying different examples to the definition
- **CO3:**Identify necessary and sufficient conditions for a non-empty subset of a group to become a subgroup and develop skills in solving problems in groups which facilitate and solving of problems in Cosets
- **CO4:**Advance their ability to apply the necessary and sufficient conditions studied, to solve the problems in Normal Subgroups and learn the concept of Quotient group
- **CO5:**Be able to deduce other homomorphism theorems from fundamental theorem of Homomorphism and also illustrate the concept of auto morphisms and related theorems
- **CO5:**Be able to understand the concepts of permutation groups, cyclic groups, finding the number of generators of a cyclic group.
- **CO6:** Be able to understand the ring theory concepts with the help of knowledge in group theory and to prove the theorems.
- **CO7:** Be able to understand the applications of ring theory in various fields

COURSE SYLLABUS

UNIT – I : **GROUPS :** Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

UNIT – II: SUBGROUPS: Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition- examples-criterion for a complex to be a subgroups. criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups.

CO-SETS AND LAGRANGE'S THEOREM: Cosets Definition – properties of Cosets– Index of a subgroups of a finite groups–Lagrange's Theorem.

UNIT –III: NORMAL SUBGROUPS: Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group – quotient group – criteria for the existence of a quotient group.

HOMOMORPHISM: Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – auto morphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

UNIT – IV : PERMUTATIONS AND CYCLIC GROUPS :

PERMUTATION GROUPS: Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

CYCLIC GROUPS:- Definition of cyclic group – elementary properties – classification of cyclic groups.

UNIT – V: RINGS: Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws on Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field, Sub Rings, Ideals.

CO-CURRICULAR ACTIVITIES: Seminar/ Quiz/ Assignments/ Group theory and its applications / Problem Solving

TEXT BOOK: A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others, published by S.Chand& Company, New Delhi.

REFERENCE BOOKS :

1. Abstract Algebra, by J.B. Fraleigh, Published by Narosa Publishing house. (2006)
2. A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others, Published by S.Chand & Company, New Delhi. (2003)
3. Modern Algebra by M.L. Khanna.(1998)
4. Theory of Numbers – Prakash Om (1982) – Lakshmi Publications
5. Introduction to Analytic Number Theory – Tom M. Apostol – Narosa Publishing House, New Delhi. (2001)
6. Rings and Linear Algebra by Pundir&Pundir, published by PragathiPrakashan

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