Dilla University

College of Natural and Computational Science

Department of Mathematics

Course Title: Algebra I   Course Code: Math 601

Credit hr: 3hrs   Tutorial: 2hrs   Course hrs: 3

Aims of the course: The main purpose of this course is to introduce beginning graduate students in mathematics to the most common algebraic structures, the theory of groups and rings. Moreover, it is designed to prepare students for further studies in mathematics and/or related fields. Students become familiar with the fundamentals of linear algebra including digitalization, Cayley-Hamilton theorem and various canonical forms.

Course Description: The course covers basic terminologies on groups, permutation groups, direct product/sum, free groups, free products, generation and relation, structure of groups, action of a group on a set, the Sylow Theorem, decomposable groups, finitely generated Abelian groups, solvable and nilpotent groups, the theory of rings, localization and quotient rings, unique factorization domain (UFD), principal ideal domain (PID) and Euclidean domains (ED), polynomial rings.

Course Objectives: On completion of the course successful students will be able to:

- describe a group and different types of groups
- comprehend isomorphism between groups
- find direct product of two or more given groups
- apply Sylow's theorems
- grasp the basic properties of rings, subrings, ideals and integral domains
- comprehend properties of polynomial rings over various domains
- perform operations on polynomials like the division algorithm
- comprehend the fundamental theorem of finitely generated abelian groups

Chapter 1: **Groups**

   1.1   Semi groups, monoids and groups

   1.2   Homomorphisms

   1.3   Subgroups and cosets

   1.4   Cyclic groups

1.5 Normal subgroups and quotient groups

1.6 Isomorphism theorems

1.7 Automorphisms

1.8 Conjugacy and G-Sets

1.9 Permutation groups

1.10 Direct products and direct sums

Chapter 2: **STRUCTURE THEOREMS OF GROUPS**

2.1 Finitely generated abelian groups

2.2 The Sylow theorems

2.3 Classification of finite groups

2.4 Nilpotent and solvable groups

2.5 Normal and subnormal series

Chapter 3: **RINGS**

3.1 Definition, examples and elementary properties

3.2 Subgroups and characteristics of a ring

3.3 Ideals and Homomorphisms

3.4 Factorization in commutative rings

3.5 Rings of quotients and localization

3.6 Rings of polynomials and formal power series

3.7 Factorizations in polynomial rings

Mode of Assessment:

o Assignment: 20%

o Mid exam: 30%

o Final exam: 50%

Text book: Hungerford, T.H.: Algebra, Springer-Verlag, 1974.

References:

- Lang, S.: Algebra, Addison-Wesley, 1970.

- Goldstein. L.J: Abstract Algebra: A First Course, Prentice-Hall Inc., 1973.