

Kotebe University of Education
College of Natural and Computational Sciences
Department of Mathematics

Course Syllabus on ‘Algebra I’

Course Code: Math 601

Credit Hours/ ECTS: 3 / 7

Lecture hrs: 4, **Collaborative Learning hrs:** 2, **Independent learning hrs:** 5

Length of time to complete the course: 16 weeks

Total number of load hours the student will carry to complete the course: 189 hrs

Pre-requisite course: None

Program: M.SC. in Mathematics

Course Objective

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 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, PID and Euclidean domains.

Learning Outcomes

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

Mode of Delivery: This course will be offered in a semester based mode of delivery

Course Contents

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

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

3. Rings

- 3.1 Definition, examples and elementary properties
- 3.2 Subrings 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

4. Field Extensions

- 4.1 Basic definitions and examples
- 4.2 Basic properties
- 4.3 Simple and algebraic extensions
- 4.4 Finitely generated extensions
- 4.5 Splitting fields
- 4.6 Algebraically closed fields
- 4.7 Characteristic of a field, finite fields
- 4.8 Roots of unity
- 4.9 Ruler and compass constructions

Teaching-Learning Strategy/Methods

Lectures, Tutorial, Group Assignments

Assessment Strategy/Methods

- Assignment: 20%, Tests: 30%, Semester Examination: 50%

Course Policy

A student has to

- Attend at least 80% of the classes
- Take all continuous assessments
- Take final examination
- Respect all rules and regulations of the University

References

- [1] Hungerford, T.H.: Algebra, Springer-Verlag, 1974.
- [2] Lang, S.: Algebra, Addison-Wesley, 1970.
- [3] Goldstein. L.J: Abstract Algebra: A First Course, Prentice-Hall Inc., 1973