Tribhuvan University
Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Algebra II **Full Marks:** 75
Course No. : Math 301 **Pass Mark:** 35%
Level : B.Sc. **Year:** III
Nature of Course: Theory
Period per week: 9 (6 Theory + 3 problems classes)

Course Description:
This course is designed for continuation of second year Algebra I (Math201) of B.Sc. four years level. The main aim of this course is to provide knowledge of linear algebra and modern algebra.

Course Objective:
The main objectives of this course structure is to enable the students

(i) To develop in-depth knowledge and good theoretical background in algebra;
(ii) To take up higher studies;
(iii) To sustain interest in and promote enjoyment of algebra and its applications in various branches of mathematics and physical and social sciences;
(iv) To get associated with teaching in the field related to algebra.
(v) To compete with graduates from various other universities in the field of algebra.

Course Contents:
Unit 1. **Vector Spaces, Matrices and Linear Mappings**: Definitions; Bases; maximal set and subset; The space of Matrices; Linear equations; Multiplications of matrices; mappings, Linear mappings; The space of linear maps; Composition and inverse of linear mappings 18 Lectures
Unit 2 Linear Maps and Matrices: The linear map associated with a matrix; The Matrix associated with a linear map; Bases, Matrices, and linear maps. 7 Lectures
Unit 3. **Scalar Products and orthogonality**: Scalar products; orthogonal bases, Positive definiteness case; Application to linear equations (the rank); Bilinear maps and matrices; General orthogonal bases; Dual spaces and scalar products; Quadratic forms; Sylvester's theorem. 18 Lectures
Unit 4. **Symmetric, Hermitian, and Unitary Operators**: Symmetric Operators; Hermitian operators; Unitary operators. 8 Lectures
Unit 5. **Eigenvectors and Eigenvalues, Triangulation, polynomials of matrices and primary decomposition**: Eigenvectors and eigenvalues; The characteristic polynomial; Polynomials; Polynomials of matrices and linear maps; Existence of triangulation; Theorem of Hamilton-Cayley; Diagonalisation of unitary maps; Application of the decomposition of vector spaces. 17 Lectures
Unit 6. **Groups**: Subgroups of finite cyclic groups; Generating sets and Cayley Diagraph; Group of permutation; Orbits, Cycles, and the alternating groups; Direct Products. 23 Lectures
Unit 7. Homomorphisms and Factor Groups: Homomorphisms; Factor groups; Factor- group computations and simple groups; Group action on aset. 14 Lectures

Unit 8. Rings: Rings and fields; Divisors of zero and cancellation, The characteristic ring; Fermat's and Euler's theorem; The field of quotients of an integral domain; Rings and polynomials; Factorization of polynomials over a field. 19 Lectures

Unit 9. Ideals and Factor Rings, Factorization: Homomorphisms and factor rings; Prime and maximal ideals; Unique factorization domain; Euclidean domain; Gaussian integers. 18 Lectures

Unit 10. Fields: Introduction to extension fields; Algebraic extensions; Finite fields. 8 Lectures

Reference Books:

1. Serge Lang; *Linear Algebra*, Third Edition (Corrected Printing, 2004), Springer.
2. John. B. Fraleigh; *A First Course in Abstract Algebra*, Seventh Edition, Pearson.
3. I.N. Herstein; *Topics in Algebra,* Vikas Publication, India.
4. N.S. Gopal Krishan; *University Algebra,* Orient Longman, India.