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

Course Title: Algebra I   **Full Marks:** 75

Course No. : Math 201   **Pass Mark:** 35%

Level   : B.Sc.   **Year: II**

Nature of Course: Theory   **Period per week:** 9 (6 Theory + 3 tutorial)

Course Contents:

Unit 1. **Matrices and Determinants**: Algebra of matrices, Square matrix as product of lower and upper triangular matrices, transpose of a matrix and its properties, partition of matrices, symmetric and skew symmetric matrices, trace of a matrix, matrices of complex entries, Hermitian and skew- Hermitian matrices, orthogonal and unitary matrices, determinant of square matrix, properties of determinants, minors and co-factors, product of determinants, adjoint and inverse of the square matrix and their properties.   15 Lectures

Unit 2. **System of Linear Equations**: System of homogeneous and non-homogeneous linear equations, rank of a matrix, reduction to echelon form, linear dependence and independence, properties of rank, row rank and column rank, rank of the product of matrices, consistency and inconsistency of a system of linear equations, solution of homogeneous and non-homogeneous system of linear equations, elementary transformation of a matrix, inverse of a matrix by elementary transformation, characteristic equation of a matrix , Cayley-Hamilton theorem (no proof).   12 Lectures

Unit 3. **Binary Operation and Properties of Integers**: Binary operations, algebraic structure, equivalence relations and equivalence classes, properties of integers and prime number, divisors and greatest common divisor, prime factors and unique factorization theorem (no proof), congruencies and residue classes.   12 Lectures

Unit 4. **Groups**: Semi-group and groups and their examples, order of a group, elementary properties of groups, integral power of an element, Subgroups and their properties, cyclic groups, coset, order of an element of a group, Lagrange's theorem ,centre, normalizer.   18 Lectures

Unit 5. **Group continued**: Permutation groups, cyclic permutation, even and odd permutation, normal subgroup, quotient group and their properties, homomorphism, kernel and image of homomorphism, isomorphism.

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Unit 6. **Rings and Fields**: Rings, Special classes of rings, elementary properties of rings, zero divisor, division ring, integral domain, field and their properties, Boolean ring, subrings, ideals and quotient rings, homomorphism of rings, maximal ideal of rings.   15 lectures

Unit 7. **Vector in Real n-Space**: Point in n-space, algebraic operations of points in n-space and their properties, scalar product, norm, distance, angle, scalar and vector projections and their geometrical interpretations, orthogonality. 8 Lectures

Unit 8. **Vector Space and Subspaces**: Vector space and subspaces, elementary properties, linear combination linear dependence and independence, basis and dimension, direct sum, inner product, orthogonality and orthonormality, orthogonal and orthonormal basis. 14 Lectures

Unit 9. **Linear Transformations**: Transformations, linear transformation, kernel and image of linear transformations, algebra of linear transformation, matrix as a linear transformation, eigenvalues and eigenvectors. 10 Lectures

Unit 10. **Theory of polynomial Equations**: polynomial over an integral domain, division algorithm, division of a polynomial, zero of a polynomial, Rolle's theorem(no proof),properties of equations, Descartes rule of signs, relation between roots and coefficients, application to the solution of an equation, symmetric function of roots, transformation of equations, transformation in general, multiple roots, sum of the power of roots, reciprocal equations, Binomial equation. 15 Lectures

Unit 11. **Cubic and Biquadratic Equations**: Algebraic solution, algebraic solution of the cubic, nature of roots of cubic, equation of square difference of cubic, nature of roots from Cardan's solution and application to the numerical examples, solution by symmetric functions of roots, solution of the biquadratic and the radical.

10 Lectures

Unit 12. **Numerical solution of equations**: Numerical equations, limit of the roots of equations, integer roots, method of divisors, Newton's method of approximation, Horner's method. 7 Lectures

Books suggested:

1. I.N. Herstein ; *Topics in Algebra*, vikas Publishing House pvt. Ltd.
2. S. Lang; *Introduction to Linear Algebra*, Second Edition, Springer.
3. R.M. Shrestha & S. Bajracharya; *Linear Algebra, Groups, Rings & Theory of Equations*, Sukunda Pustak Bhavan, Kathmandu
4. H.N. Bhattarai & G.P. Dhakal; *Undergraduate Algebra,* Vidharthi Pustak Bhandar, kathmandu.
5. T.P. Nepal, C.R. Bhatta & Ganga Ram D.C. ; *A Text Book on Algebra*, Pradhan Book House Exhibition Road , Kathmandu .

6.   Chandrika Prasad; *A text book of Algebra & Theory of equation*, Pothishala private Ltd.
7. P. B.Bhattacharya, S.K. Jain & S.R. Nagpaul; *First course in Linear Algebra*, New Age International Publisher
8. P. B.Bhattacharya, S.K. Jain & S.R. Nagpaul; *Basic Abstract Algebra*, Cambridge, 1995.
9. N.S. Gopalakrishnan; *University Algebra*, Orient Longman.
10. P.R. Halmos; *Finite Dimensional Vector Space*, D.Van Nostrand   co., Princeten.
11. B.S. Vatssa; *Theory of Matrices*, Wiley Eastern Ltd.
12. A.R. Vasishtha; *Modern Algebra*, Krishna Prakashan Mandir,Meerut.