Course title: Algebra Full marks: 100

Course No: Math Ed 449 Pass Marks : 35

Nature of course: Theory Periods per week : 6

Level: B Ed Total periods : 150

Year: Fourth Time per period : 45 minutes

1. **Course Description**: This is an introductory course in ***Algebra*** for the students with mathematics as a minor subject. It starts to deal with binary operations and algebraic structure and discusses systematically various properties of sets which are useful for the various branches of mathematics. This course consists of eight chapters in which first three chapters deal about different types of groups ,rings and fields with their properties ,the fourth chapter discusses matrices and determinants . The remaining four chapters are related to vector space and vector algebra **.**This course expects to provide skills to prospective secondary school teachers to play with numbers and sets which they can link to their surroundings.
2. **General objectives:**

The general objectives of this course are as follows:

* To help students to analyze basic algebraic structure
* To provide students the knowledge of binary operations on sets
* To develop an understanding of concept of group ,ring and field
* To analyze the concept of group to connect with rings and fields
* To acquaint with basic concepts of linear algebra
* To develop skills in solving problems on matrix and determinant
* To provide the knowledge of vector differentiation and skills to find gradient, divergence and curl of a vector

3. **Specific Objectives and Contents**

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| **Specific Objectives**   * Discuss domain and range and types of functions with examples * Define Cartesian product, relation, equivalence relation and equivalence classes with examples * Define binary operation and verify its properties * Differentiate between algebraic structure, groupiod and semi-group with examples | **Content**  **Unit1: Binary operation and Algebraic structure (10)**  1.1 Sets, domain and range of a function  1.2 Types of function  1.3 Cartesian product, relation, equivalence relation and equivalence classes  1.4 Binary operation and its properties  1.5 Algebraic structure, groupiod and semi group and its examples |
| * Define group with examples and prove simple properties of a group * Discuss subgroup, cyclic group and permutation group with examples * Compute the product of permutations * Define cosets of a subgroup and multiplication of subgroups with examples * Discuss order of a group and prove Lagrange’s theorem * Discuss normal subgroup and quotient group with examples * Define homomorphism, isomorphism , automorphism, image and kernel of group homomorphism and discuss on simple theorems of group homomorphism | **Unit II: Group** (35)  2.1 Group and simple properties of a group.  2.2 Sub group, cyclic group ,permutation group  and product of permutations  2.3 Co-sets of a subgroup, multiplication of  subgroups ,order of a group and Lagrange’s  theorem  2.4 Normal sub group and quotient group  2.5 Homomorphism, isomorphism , automorphism ,  Kernel and image of group homomorphism   * 1. Simple theorems on group homomorphism |
| * Define ring and its types with examples * Discuss subring ,centre and characteristics of a ring and prove related theorems * Illustrate ideals and quotient rings and prove related theorems * Discuss principal ideal, prime ideal, and maximal ideal of a ring with examples * Define kernel and image of a ring homomorphism and prove theorems on the properties of ring homomorphism * Discuss field and subfield with examples | **Unit III: Rings and Fields (25)**  3.1 Rings and some special types of ring  3.2 Sub rings, centre of rings and characteristic  of a ring  3.3 Ideals and quotient ring  3.4 Principal ideal, prime ideal and maximal ideal  3.5 Homomorphism, kernel and image  of ring homomorphism  3.6 Field and sub field |
|  |  |
| * Define matrix and discuss its types * Discuss addition,subtraction and multiplication of matrices * Explain properties of determinants * Find ranks of matrices * Discuss system of linear equations and test consistency * Solve a system of linear equations of two and three variables | **Unit IV: Matrix and Determinant** (15)  4.1 Matrix and its types  4.2 Addition ,subtraction and multiplication of matrices  4.3 Determinant and its properties  4.4 Rank of matrices  4.5 System of linear equations  4.6 Consistency of linear equations  4.7 Linear equations of two and three variables |
| * Define points and discuss algebraic operations on vectors in n- space * Define and calculate norm and length of a vector * Find the angle between two vectors and discuss their properties * Prove Cauchy’s inequality, triangle inequality and Pythagorean identity | **Unit V: Vector in n- space** (10)  5.1 Points in n- space  5.2 Algebraic operations on vectors  5.3 Norm and length of a vector  5.4 Angle between two vectors and their properties  5.5 Cauchy,s inequality, triangle inequality  and Pythagorean identity |
| * Define vector space and subspaces with examples * Define linear combination, linearly dependent and independent and linear hull of vectors with examples and prove related theorems * Discuss basis and dimension of avector space with examples and prove related theorems * Define orthogonal and orthonormal vectors with examples * Discuss Gram Schimidt orthogonalization process of vectors and solve related problems * Define linear transformation, kernel and image of a linear transformation with examples and prove related theorems * Define eigen values and eigen vectors and determine eigen values and eigen vectors of a 2X2 matrix | Unit VI: Vector Space (25)  6.1 Vector spaces and subspaces with elementary properties.  6.2 Linear combination, linearly dependent, linearly independent and linear hull  6.3 Basis and dimension of a vector space  6.4 Scalar product (or Inner product) of vectors and norm of vectors  6.5 Orthogonality and orthonarmality of vectors  6.6 Gram - Schmidt orthogonalization process of vectors  6.7 Linear transformation and kernel of linear transformation  6.8 Representation of a linear transformation by a matrix  6.9 Algebra of linear transformation  6.10 Inverse of linear transformation  6.11 Eigen values and eigen vectors |
| * Define scalar triple product and prove its properties * Interpret scalar triple product geometrically * Define vector triple product and discuss its geometrical meaning * Find scalar and vector product of four vectors * Discuss reciprocal system of non-coplanar vectors | **Unit VII: Product of Vectors** (15)  7.1 Review of scalar product and vector  product of two vectors  7.2 Scalar triple product and its properties  7.3 Geometrical interpretation of scalar  triple product  7.4 Vector triple product and its geometrical  meaning  7.5 Product of four vectors  7.6 Reciprocal system of vectors |
| * Define limit, continuity and derivative of a vector valued function * State and prove necessary and sufficient conditions for a vector function to have a constant magnitude and constant direction * Define gradient, divergence and curl and illustrate with examples | **Unit VIII: Vector Differentiation** (15)  8.1 Limit, Continuity and derivative of  vector valued functions  8.2 Necessary and sufficient condition for a  vector function to have a constant magnitude  and constant direction  8.3 Gradient, divergence and curl of a vector |

1. **Instructional Techniques**

The general instructional techniques are as follows **:**

* Lecture with discussion
* Question and answer
* Problem solving and discussion

**4.2 The specific instructional techniques are as follows :**

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| --- | --- |
| **Units** | **Instructional Techniques** |
| **I** | **Discussion in group** |
| **II** | **Group discussion and individual assignment** |
| **III** | **Discussion in group and problem solving** |
| **IV** | **Project work** |
| **V** | **Individual assignment and discussion** |
| **VI** | **Problem solving and presentation** |
| **VII** | **Problem solving** |
| **VIII** | **Group work and presentation** |

**5. Evaluation:**

The office of the Controller of Examination will conduct the final examination at the end of the academic session to evaluate the student’s performance. The types and number of questions , marks allocated to objective and subjective questions will be as follows :

|  |  |  |  |
| --- | --- | --- | --- |
| Types of questions | Total questions to be answered | Allocated marks | Total marks |
| Multiple choice questions | 20 | 20 x 1 | 20 |
| Short answer questions | 8with 3 or | 8 x 7 | 56 |
| Long answer questions | 2 with 1 or | 2 x 12 | 24 |

**6. Recommended Books and References**

**6.1 Recommended Books**

Dummit, D.S.&Foote R. (2002) ,*Abstract algebra*. New Delhi: Wiley India Reprint.(I-III)

Herstine, I. N. (1986), *Abstract algebra*. New York:Macmillan Publishing Company.(I-III)

Lang, S. (1973) , *Linear algebra*. New York: Addison Wesley.(IV-VI)

Prasad, L. (1995*) ,Vector analysis*. Patna: Paramount Publication. (VII-VIII)

**6.2 Reference Books**

Bhattarai, B. N. (2074). *A text book on modern algebra*, Kathmandu: Cambridge Publication.

Koirala ,S. P.and Subedi B.H. (2012), *Vector analysis,* Kathmandu: Cambridge Publication.

Shrestha, R. M. (2006) ,*Elementary linear algebra*,Kathmandu: Sukunda Pustak Bhawan

Shrestha , B. K.(2073),*Elementary book of higher algebra* , Kathmandu : Radium Publication Pvt. Ltd .

Singh, M. B. (2014) ,*A text -book of vector analysis* ,Kathmandu: Sukunda Pustak Bhawan.

Vasistha, A. R**. (2000) ,***Modern algebra,* Meerut: Krishna Prakashan media P. Ltd

Vaidya, B. L.(1992) ,*Vector analysis*, Kathmandu: Ratna Pustak Bhandar.

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