MATHEMATICS I

COURSE CODE: BCA 104

NATURE OF COURSE: THEORY & LAB **CREDIT HOURS** 3

YEAR/SEMESTER: I/I

Course Description:

The course covers the concepts of real numbers, functions and their graphs, sequences and series, matrices and determinants, analytical geometry, vector space, and permutations and combinations. The course is a foundation for computer applications and programming. Teachers and facilitators are suggested to connect mathematical concepts with the programming and make them more applicable to real-world problems during their theoretical and practical teaching.

Course objectives:

The objectives of this course are to make students able to

- Understand the basic mathematical concepts required to understand computer applications courses,
- Understand the nature of real numbers, their property, and compactness, functions and their types, and the use of functions in graphs.
- Solve different types of sequences and their connections to real-world problems,
- Solve the matrix-related problems and their uses in computer programming.
- Understand the standard equations and parts of the conic sections and the relation between the Cartesian and polar equations.
- Notations and meanings of vectors and their operations, and the concept of linear dependency and independence.
- Meaning and problems related to permutations and combinations.

Course content

Unit 1: Logic, Relations, Functions, and Graphs **10 Hrs.**

1.1 Elementary logic,

1.2 Real number system,

1.3 Field and ordered axioms of real numbers,

1.4 Intervals, rational and irrational numbers,

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1.5 Absolute value, and its properties, complex numbers and their properties,

1.6 Ordered pairs, Cartesian product, relation, equivalence relation,

1.7 Functions, composite functions, domain and range, inverse function, types of functions (Identity, constant, algebraic, trigonometric, exponential and logarithmic), combination of functions,

1.8 Graphs of different types of functions,

Unit 2: Sequence and Series **7 Hrs.**

2.1 Sequence and Series (Arithmetic, Geometric and Harmonic) and their properties,

2.2 Means (AM, GM, and HM), and theorems to show the relation among them,

2.3 nth term and sum of arithmetic series, & finite and infinite geometric series,

2.4 Sum of first n-natural numbers, their squares and cubes,

2.5 Arithmatico-geometric series.

Unit 3: Matrices and Determinants **10 Hrs.**

3.1 Definitions and types of matrices, algebra of matrices,

3.2 Determinants, transpose, minors, and cofactors of matrices,

3.3 Properties of determinants (without proof), singular, non-singular, adjoint, and inverse of a matrix,

3.4 Rank of a matrix,

3.5 Linear and orthogonal transformation, composite transformation, and its applications to computer graphics,

3.6 Characteristic equations, Eigenvalues and Eigenvectors.

Unit 4: Analytical geometry **7 Hrs.**

4.1 Defining terms of conic sections,

4.2 Standard equations of circle, parabola, ellipse, hyperbola and their graphs.

4.3 Conic sections in terms of eccentricity,

4.4 Polar equations of the circle, ellipse, parabola and hyperbola.

Unit 5: Vector and Vector Space **7 Hrs.**

5.1 Definition of vector and scalar, magnitude and distance and unit vector,

5.2 Operations on vectors (addition, subtraction, scalar multiplication)

5.3 Scalar product and vector product of two and three vectors with their geometrical interpretations,

5.4 Vector space, subspace,

5.5 Linear combination, linear dependence and independence,

5.6 Scalar product, norm and orthogonality.

Unit 6: Permutations and Combinations **7 Hrs.**

6.1 Basic counting principle

6.2 Deduction method for the formulas for permutations and combinations

6.3 Relation between permutations and combinations.

6.4 Permutation of n objects (all different and not all different, but taking all at a time when the objects are not all different), circular permutations,

6.5 Combination of different objects and their properties.

Laboratory works

Students are expected to implement Python, MATLAB, and Mathematica to solve the numerical problems and compare the solution with that of pen and paper.

Examination Scheme				
Internal Assessment		External Assessment		
Theory	Practical	Theory	Practical	
20	20 (3hrs)	60 (3 Hrs)	---	100

Required readings

Bajracharya, B. C., (2082). *Basic Mathematics*, Sukunda Publication.

Boice, W.E., Diprima, R.C., & Mead, D. B. (2017). *Elementary Differential Equations and Boundary Value Problems*, John Wiley & Sons.

Budnick, F. S., (2019). *Applied Mathematics for Business Economics and Social Sciences*, McGraw-Hill,

Chand, K. B., Sapkota (2079), B. P., *Principles of Mathematical Analysis*.

Lay, D. C. (2003). *Linear algebra and its applications*. Pearson Education India.

Thomas G. B., Finney, R. L. (1995). *Calculus and Analytical Geometry*, Narosa Publishing House. (Text Book)