

## 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

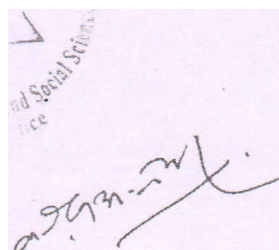
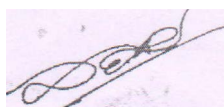
- Understand the basic mathematical concepts required to understand computer applications courses,
- Understand the nature of real numbers, their property, and compactness, functions and their types, and the use of functions in graphs.
- Solve different types of sequences and their connections to real-world 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,



- 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**

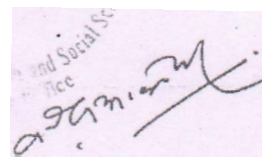
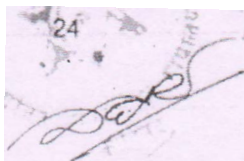
**10 Hrs.**

- 3.1 Definitions and types of matrices, algebra of matrices, 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<br>(3hrs) | 60<br>(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,



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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)

