MATHEMATICS II

COURSE CODE: BCA 154

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

YEAR/SEMESTER: I/I

Course Description:

The course covers the concepts of Limit and Continuity, Derivatives of Algebraic, Trigonometric, Exponential, and Logarithmic functions, and their applications. It also covers Integration and its Applications, Volume and Surface Integral of some selected functions, and Numerical Integration using Trapezoidal and Simpson's Rule. Ordinary and Partial Differential Equations, their examples and uses are also discussed in this course. Other contents of the course include Optimization Problems like Simplex Method for two variables, and Gauss-Seidel, Gauss Elimination, Matrix Inversion, Bisection, and Newton-Raphson Method for solving the linear equations.

Course Objectives:

The objective of this course is to enable students to

- understand the concept of limit and continuity of functions and their connection to the derivative,
- differentiate different types of functions, geometrical meaning of the derivative, and its applications to real-world problems,
- integrate functions, understand their meaning and applications, including the surface and volume integrals,
- solve ordinary and partial differential equation and their connections to real-world problems,
- calculate the optimization problems, describe and interpret the graphical and numerical solutions.

Course contents:

Unit 1: Limit and Continuity **7 Hrs.**

1.1 Definition of limit including epsilon-delta condition, right and left hand limit, and its interpretation

1.2 Algebraic properties of limit

1.3 Definition and conditions of continuity and discontinuity

1.4 Continuity of algebraic, Trigonometric, and exponential functions, examples, and counterexamples.

Unit 2: Derivatives **7 Hrs.**

2.1 Definition and geometrical meaning of derivatives,

2.2 First principle (or by definition) method to differentiate algebraic, trigonometric, exponential, and logarithmic functions,

2.3 Rules of derivatives (sum, product, power, chain, and quotient rule),

2.4 Derivatives of inverse circular, hyperbolic functions and implicit functions,

2.5 Higher order derivatives,

2.6 Relation between derivative and continuity

2.7 Definition and examples of partial derivatives

Unit 3: Applications of Derivatives **8 Hrs.**

3.1 Increasing and decreasing functions,

3.2 Equation of tangents and normals using first derivatives,

3.3 L' Hospital's rule,

3.4 Angle between two lines,

3.5 Maxima and minima, absolute maxima and minima, concavity, stationary points and points of inflection,

3.6 Statement and geometrical interpretation of Rolle's theorem, Cauchy Mean-value theorem and Generalized Mean-value theorem,

3.7 Taylor's theorem, Maclaurin theorem (without proof) and its use in expansion of some simple functions,

3.8 Applications of derivatives in Economics,

3.9 Rate measures

Unit 4: Anti-derivative and its Applications **8 Hrs.**

4.1 Definition and geometrical meaning of integration,

4.2 Basic integration formulas for algebraic, trigonometric, exponential, and logarithmic functions,

4.3 Trigonometric substitution for basic functions, Integration by parts (Product rule for integration),

4.4 Partial fractions,

4.5 Improper integral,

4.6 Definite integral in terms of Riemann sum, and fundamental theorem of integral calculus

4.7 Applications of definite integral (Area under curve, area between curves, Quadrature & rectification)

4.8 Surface and volume integrals,

4.9 Trapezoidal and Simpson's Rule for numerical integration

Unit 5: Differential Equations **8 Hrs.**

5.1 Definition, order, and degree of differential equations,

5.2 Differential equations of first order and first degree,

5.3 Variables separable, homogeneous, exact, and linear differential equations,

5.4 Reducible to linear form,

5.5 Partial differential equations with some basic examples

Unit 6: Computational Methods **10 Hrs.**

6.1 Linear programming problems,

6.2 Linear inequalities in two variables and their graphical solutions,

6.3 Simplex Method (up to 3 variables), Duality problems

6.4 Matrix inversion method,

6.5 Gauss Elimination, Gauss-Seidel method,

6.6 Bisection method and Newton-Raphson Method for non-linear equations

Laboratory Works

Students are expected to use Python, MATLAB, or Mathematica to solve the numerical problems of each units 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 reading:

Bajracharya, B. C. (2025). *Basic Mathematic,* Sukunda Pustak Bhawan,

Budnick, F. S. (2017). *Applied Mathematics for Business Economics and Social Sciences.* McGraw-Hill,

Chand, K. B., Sapkota, B. P. (2022). *Principles of Mathematical Analysis.* Pinnacle Publication.

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

Stewart, J., Clegg, D., Watson, S. (2020). *Calculus.* Cengage|webassign.

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