MATH-351 Numerical Methods - Course Contents

a. **Credit Hours:** 3+0

b. **Text Book:** Numerical Analysis (7^{th} ed) By Burden & Faires

c. **References:**

1. Curtis F.Gerald Patrick O.Wheatley: Applied Numerical Analysis, Addison-Wesley

2. Numerical Methods Using Matlab (4^{th} Edition) By John H. Mathews and Kurtis D. Fink , Pearson Education.

3. E. Kreyszing. Advanced Engineering Mathematics 9^{th} ed

d. **Course Objectives:** To introduce the field of computational techniques for solving problems concerning Calculus, Linear algebraic and Differential Equations.

e. **Course Outcomes:** After successful completion of this course, a student should be able to:

1. Solve one variable non-linear equation.
2. Estimate the function values using different interpolation techniques.
3. Calculate complicated integrals numerically.
4. Solve very large system of linear equations arising in any mathematical model of real world phenomena.
5. Solve some classes of ODE's and PDE's.

f. **Topic**

I. Mathematical Preliminaries

1) Round off error and Computer arithmetic

2) Algorithms and Convergence

II. Iterative Methods for the Solutions of Non-Linear Equations (convergence analysis)

1) Bisection Method

2) Fixed point Method

3) Newton-Raphson Method

III. Interpolation

1) Introduction
2) Lagrange Interpolation
3) Newton's Divided Difference Interpolation
4) Forward Difference and Backward Difference Interpolations.
5) Introduction to Cubic Spline Interpolation
6) Clamped cubic spline
7) Natural spline

IV. Numerical Differentiation

V. Numerical Integration

1) Elements of Numerical Integration
2) Rectangular , Trapezoidal , Simpson's Rule

VI. Numerical Methods in Linear Algebra

1) LU Factorization , Doolittle's , Crouts's and Cholesky's Methods
2) Iterative Methods for Systems of Equations
3) Jacobi's Method, Gauss-Seidel Method
4) Evaluation of Eigenvalues by Iteration: Power Method.

VII. Solution of 1^{st} and 2^{nd} Order Ordinary Differential Equations

1) Introduction
2) Euler Method
3) Heun's Method
4) Runge-Kutta Methods

VIII. Solution of Elliptic Partial Differential Equations

IX. Solution of Parabolic PDEs: Crank-Nicolson Method

X. Solution of Hyperbolic PDEs