

# 17HS052 ADVANCED NUMERICAL ANALYSIS

## Course Description and Objectives:

To understand appropriate numerical methods to solve algebraic and transcendental equations. To perform an error analysis for various numerical methods and derive appropriate numerical methods to solve definite integrals. To develop appropriate numerical methods to solve a system of linear equations and special kinds of differential equations such as elliptic, parabolic and hyperbolic differential equations.

## Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Solve algebraic and transcendental equations using appropriate numerical methods.
2	Solve approximate a function using appropriate numerical methods.
3	Derive numerical methods for various mathematical operations.
4	Tasks such as interpolation, differentiation, integration and the solution of linear and nonlinear equations.
5	Analyze and evaluate the accuracy of common numerical methods.

## Skills:

1. Apply numerical methods to obtain approximate solutions to mathematical problems.
2. Know the basics of numerical methods to solve different equations.
3. Understand appropriate numerical methods.

## Unit – I (10 Hours)

**Curve Fitting:** Least – Squares curve fitting procedures, fitting a straight line, nonlinear curve fitting, Curve fitting by a sum of exponentials.

## UNIT- II (12 hours)

**Numerical Differentiation:** Derivatives using Newton’s forward difference formula, Newton’s backward difference formula, Derivatives using central difference formula, Stirling’s interpolation formula, Newton’s divided difference formula, Maximum and minimum values of a tabulated function.

## UNIT- III (12 hours)

**Numerical Integration:** General quadrature formula on errors, Trapezoidal rule, Simpson’s 1/3 – rule, Simpson’s 3/8 – rule, and Weddle’s rules, Euler – Maclaurin Formula of summation and quadrature, The Euler transformation.

#### **UNIT – IV (14 hours)**

**Solutions of simultaneous Linear Systems of Equations:** Solution of linear systems – Direct methods, Matrix inversion method, Gaussian elimination methods, Gauss-Jordan Method, Method of factorization, Solution of Tridiagonal Systems,. Iterative methods: Jacobi’s method, Gauss-Siedal method.

#### **UNIT – V (12 Hours)**

**Numerical solution of ordinary differential equations:** Introduction, Solution by Taylor’s Series, Picard’s method of successive approximations, Euler’s method, Modified Euler’s method, Runge – Kutta methods.

#### **Reference Books :**

1. Numerical Analysis by S.S.Sastry, Prentice Hall India (Latest Edition).
2. Numerical Analysis by G. Sankar Rao, New Age International Publishers, Hyderabad.
1. Finite Differences and Numerical Analysis by H.C Saxena, S. Chand and Co., New Delhi.
4. Numerical methods for scientific and engineering computation by M.K.Jain, S.R.K.Iyengar, R.K. Jain.

#### **Suggested Activities:**

Seminar/ Quiz/ Assignments