Numerical Analysis

Contact Hours:
Theory = 48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

SUGGESTED COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

Ser	CLO	Domain	Taxonomy level	PLO
1.	Apply different numerical methods to perform polynomial interpolation, curve fitting, differentiation, integration, and estimation of algebraic nonlinear equations.	Cognitive	C3	1
2.	Solve ordinary differential equations and compute optimum points in optimization problems using numerical techniques.	Cognitive	C4	1
3.	Apply a simulation tool to implement various numerical methods.	Cognitive	C3	5

RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Knowledge:	☑	7	Environment and Sustainability:	☐
2	Problem Analysis:	☐	8	Ethics:	☐
3	Design/Development of Solutions:	☐	9	Individual and Team Work:	☐
4	Investigation:	☐	10	Communication:	☐
5	Modern Tool Usage:	☑	11	Project Management:	☐
6	The Engineer and Society:	☐	12	Lifelong Learning:	☐

Course outline:

Introduction to Numerical Analysis

- Introduction
- Measuring Errors
- Sources of Errors
- Propagation of Errors

Solution of Nonlinear Equations

- Bisection Method
- Newton Raphson Method
- Secant Method
- False Position Method

Regression and Interpolation

- Linear Regression
- Nonlinear Regression
- Adequacy of Regression

- Direct Method Interpolation
- Newton's Method of Interpolation
- Lagrange Interpolation
- Spline Interpolation

Numerical Differentiation and Integration

- Numerical Differentiation
- Continuous Functions
- Discrete Functions
- Numerical Integration
- Trapezoidal Rule
- Simpson's $^1/_3$Rule
- Simpson's $^3/_8$ Rule
- Gauss Quad Rule
- Improper Integrals

Initial Value Problems for Ordinary Differential Equations

- Elementary Theory of Initial Value Problems
- Euler's Method
- Finite Differential Method
- Runge Kutta Methods
- Shooting Method
- Higher Order Differential Equations

Numerical Optimization

- Golden Section Search Method
- Newton's Method
- Direct Search Method
- Gradient Search Method
- Simplex Method

Recommended Books:

- Numerical Analysis by Richard L. Burden
- Numerical Methods with Applications by Autar K. Kaw