Numerical Analysis

Course Code	Credit Hours
Math--331	3-0

Course Description

This course provides a concise exploration of essential topics in numerical analysis with a focus on practical applications in engineering. Topics include error analysis, interpolation methods, numerical differentiation and integration techniques, solutions for linear systems, iterative methods for linear and nonlinear equations, numerical methods for solving initial and boundary value problems, computing eigenvalues, and optimization methods. Relevant engineering case studies are integrated throughout, offering students a robust understanding of numerical methods and their application in solving real-world engineering problems.

Text Book:

1. Numerical Analysis: By Richard L. Burden, J. Douglas Faires
2. Numerical Methods for Scientists and Engineers by R.W. Hamming
3. Numerical Methods for Engineers by Steven C. Chapra and R. P.Canale

Reference Book:

Prerequisites :

Nil**.**

ASSESSMENT SYSTEM FOR THEORY

	Without Project (%)	With Project/Complex Engineering Problems (%)
Quizzes	15	10-15
Assignments	10	5-10
Mid Terms	25	25
Project	-	5-10
End Semester Exam	50	45-50

ASSESSMENT SYSTEM FOR LAB

Lab Work/ Psychomotor Assessment/ Lab Reports	70%

Lab Project/ Open Ended Lab Report/ Assignment/ Quiz	10%
Final Assesment/ Viva	20%

Teaching Plan

Week No	Topics/Learning Outcomes
1-2	Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Newton forward and backward difference formula for interpolation, Central difference interpolation formula, Lagrange's interpolation, Error in interpolation, Relevant engineering case studies
3-4	Derivation of numerical differentiation of first order and second order derivatives using two points and three points, Trapezoidal rule, Simpson's rules
5	Composite Trapezoidal, Simpson Rules and Romberg integration
6	Applications of numerical differentiation and integration in engineering, Relevant cases
7	Solution of system of linear algebraic equations, Gauss elimination method, LU factorization
8	Bisection method, Newton's method, Secant method, Solution of system of linear equations by Jacobi and Gauss Seidel
9	MSE
10	Applications of system of theses (linear/ non-linear algebraic equations) in engineering disciplines, Relevant case studies
11-12	Euler's method and its variations. Runge-Kutta methods of order 2 and 4, Linear multistep methods, Numerical solution of system of ODEs
13	Eigenvalues and Eigenvectors of matrix, power method, Inverse power method
14	Applications of ODEs and eigenvalues in civil engineering
15	Unconstrained Optimization, Lagrange Multipliers, Method of steepest descent
16	Applications of optimization in civil engineering

17-18	**End Semester Exam**

Practical: Nil.