Course Title: **Numerical Methods (3 Cr.)**
Course Code: **CACS252**
Year/Semester: **II/IV**
Class Load: **6 Hrs. / Week (Theory: 3 Hrs, Tutorial: 1, Practical: 2 Hrs.)**

Course Description

This course covers solution of nonlinear equations, interpolation and approximation, numerical differentiation and integration and solution of linear algebraic equation, ordinary differential equations and partial differential equations. It provides knowledge for numerical analysis.

Course Objectives

The general objectives of this subject are to make students familiar with the theory of numerical analysis for solving algebraic and transcendental equations, solution of ordinary and partial differential equations, numerical differentiation and integration.

Course Contents

Unit 1 Solution of Nonlinear Equations **10 Hrs.**

Introduction, Types of Equation, Errors in Computing, The Bisection Method; The Method of False Position, Newton- Raphson Method, Solution of System of Nonlinear Equation, Fixed Point Iteration and Convergence

Unit 2 Interpolation and Approximation **8 Hrs.**

Introduction, Errors in Polynomial Interpolation, Lagrange's Polynomials, Newton's Interpolation using Difference and Divided Differences, Cubic Spline Interpolation, Least Squares Method for Linear and Non-linear Data.

Unit 3 Numerical Differentiation and Integration **5 Hrs.**

Introduction to Numerical Differentiation, Newton's Differentiation Formulas, Numerical Integration (Trapezoidal Rule, Simpson's 1/3 rule, 3/8 rule); Romberg Integration; Numerical Double Integration.

Unit 4 Solution of Linear Algebraic Equations **10 Hrs.**

Review of the existence of solutions and properties of matrices, Consistency of a Linear System of Equations, Gaussian Elimination Method, Gauss-Jordan Method, Inverse of matrix using Gauss Elimination Method, Method of factorization, Iterative Methods(Jacobi & Gauss-Seidel Iteration),Power Method.

Unit 5 Solution of Ordinary Differential Equations **7 Hrs.**

Introduction to Differential Equations, Initial Value Problem, Taylor Series Method, Picard's Method, Euler's Method and Its Accuracy, Heun's method,

Runge-Kutta Methods, Solution of Higher Order Equations, Boundary Value Problems, Shooting Method and Its Algorithm.

Unit 6 Solution of Partial Differential Equations **5 Hrs.**

Introduction to Partial Differential Equations, Deriving Difference Equations, Laplacian Equation and Poisson's Equation.

Laboratory Works

Laboratory works will consist of program development and testing of Non-linear Equations, Interpolation, Numerical Differentiation and Integration, Linear Algebraic Equations, Ordinary and Partial Differential Equations using C or C++Builder.

Teaching Methods

The general teaching pedagogy includes class lectures, group discussions, case studies, guest lectures, research work, project work, assignments (theoretical and practical), and examinations (written and verbal), depending upon the nature of the topics. The teaching faculty will determine the choice of teaching pedagogy as per the need of the topics.

Evaluation

Examination Scheme				
Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	
20	20 (3 Hrs.)	60 (3 Hrs.)	-	100

Text Books

1. C.F. Gerald and P.O. Wheatley, "*Applied Numerical Analysis*", 4th Edition, Addison Wesley Publishing Company, New York
2. S. S Sastry, "*Introduction to Methods of Numerical Analysis*",- Prentice- Hall India

Reference Books

1. W. Chency and D. Kinciad, "*Numerical Mathematics and Computing*", 2nd edition, Brooks/Cole Publishing Co., 1985
2. W.H. Press, B.P. Flannery et. al., "*Numerical Recipes in C*", 1st Edition, Cambridge Press, 1998.

3. S. Yakwitz and F. Szidarovszky, "*An Introduction to Numerical Computations*", 2nd Edition, Macmillan Publishing Co., New York.
4. S.S. Sastry, "*Engineering Mathematics Volume two*", Prentice-Hall of India.