



MATHEMATICS

Numerical Analysis

Type of Course	: New
Course Snapshot	: Core / UG, PG
Pre-requisites	: Knowledge of fundamentals of Calculus
Course Duration	: 30 hours / 12 weeks
Industry Support	: Any industry with R&D component

COURSE OUTLINE:

This course on NUMERICAL ANALYSIS introduces the theory and application of numerical methods or techniques to approximate mathematical procedures(such as reconstruction of a function, evaluation of an integral) or solutions of problems that arise in science and engineering.

INSTRUCTOR:

Prof. R.Usha,
Department of Mathematics
IIT Madras



ABOUT INSTRUCTOR:

Prof. R.Usha, Department of Mathematics, Indian Institute of technology Madras. She has several years of teaching experience and has offered this course on Numerical Analysis to the under-graduate students and at an advanced level to the post graduate students at IIT Madras.

COURSE PLAN:

- Week 1 : Introduction and Motivation Mathematical Preliminaries, Interpolation and Polynomial Approximation
- Week 2 : Divided difference interpolation polynomials; Existence and Uniqueness, error in interpolation
- Week 3 : Numerical Differentiation Derivation of differentiation formulas with order of accuracy; Using polynomial interpolation; using forward, backward, shift operators; Using the method of undetermined coefficients
- Week 4 : Error in these rules; related problems
- Week 5 : Numerical Solution of Ordinary Differential Equations(ODE) Initial Value Problems: Mathematical Theory of ODE; existence and uniqueness;
- Week 6 : Predictor-Corrector Methods(PC methods) Modified Eulers Method, examples; Adam- Bashforth, Adam-Moulton PC Methods
- Week 7 : Solution of Nonlinear equations(one variable: $f(x) = 0$) Mathematical preliminaries Bisection Method; examples; error analysis; convergence
- Week 8 : Fixed Point Iteration Method; convergence; Convergence acceleration for Fixed Point Iteration Method; error analysis;
- Week 9 : Solution of Linear Systems Mathematical preliminaries; matrix Algebra Direct Methods:
- Week 10 : Norms and Analysis of Errors for Direct Methods; ill-conditioning; condition number
- Week 11 : Matrix Eigenvalue Problem Eigenvalues and eigenvectors
- Week 12 : Jacobis Method for Symmetric matrices; examples; practice problems; Power Method(finding the dominant eigenvalue); inverse power Method; examples; practice problems