



NUMERICAL METHODS FOR ENGINEERS

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TYPE OF COURSE : Rerun | Core | UG

COURSE DURATION : 12 weeks (17 Aug' 20 - 9 Oct' 20)

EXAM DATE : 17 Oct 2020

PRE-REQUISITES : 12th standard Math background

INTENDED AUDIENCE : First or second year undergraduate students in any branch of engineering (or science)

COURSE OUTLINE :

The development of fast, efficient and inexpensive computers has significantly increased the range of engineering problems that can be solved reliably. Numerical Methods use computers to solve problems by step-wise, repeated and iterative solution methods, which would otherwise be tedious or unsolvable by hand-calculations. This course is designed to give an overview of numerical methods of interest to scientists and engineers. However, the focus being on the techniques themselves, rather than specific applications, the contents should be relevant to varied fields such as engineering, management, economics, etc.

ABOUT INSTRUCTOR :

Dr. Niket Kaisare is an Associate Professor of Chemical Engineering in IIT-Madras. He works in the area of modeling, design and control for energy applications. He has over 7 years of research/teaching experience in academia, and three-year experience in Industrial R&D. He uses computational software, including MATLAB, FORTRAN, Aspen and FLUENT extensively in his research and teaching.

COURSE PLAN :

- Week 1:** Introduction Motivation and applications Computation and Error Analysis Accuracy and precision; Truncation and round-off errors; Binary Number System; Error propagation
- Week 2:** Linear Systems and Equations: 1 Matrix representation; Cramer's rule; Gauss Elimination; Matrix Inversion; LU Decomposition;
- Week 3:** Linear Systems and Equations: 2 Iterative Methods; Relaxation Methods; Eigen Values
- Week 4:** Algebraic Equations: Bracketing Methods Bracketing methods: Bisection, Reguli-Falsi;
- Week 5:** Algebraic Equations: Open Methods and Optimization Open methods: Secant, Fixed point iteration, Newton-Raphson; Multivariate Newton's method
- Week 6:** Numerical Differentiation Numerical differentiation; higher order formulae
- Week 7:** Integration and Integral Equations Trapezoidal rules; Simpson's rules; Quadrature
- Week 8:** Regression Linear regression; Least squares; Total Least Squares;
- Week 9:** Interpolation and Curve Fitting Interpolation; Newton's Difference Formulae; Cubic Splines
- Week 10:** ODEs: Initial Value Problems – 1 Euler's methods; Runge-Kutta methods; Predictor-corrector methods;
- Week 11:** ODEs: Initial Value Problems – 2 Extension to multi-variable systems; Adaptive step size; Stiff ODEs
- Week 12:** ODEs: Boundary Value Problems Shooting method; Finite differences; Over/Under Relaxation (SOR)