Computational Techniques - Video course

COURSE OUTLINE

Objectives:

The development of fast, efficient and inexpensive computers has significantly increased the range of engineering problems that can be solved reliably.

Computational techniques 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 computational techniques of interest to process engineer.

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.

Software:

Since this is designed to introduce students to the art of scientific computation, it will rely on computer-based exercises to learn aspects of practical implementation. MATLAB is the official software used in this course.

Alternatively, if MATLAB is not available, SCILAB - an open-source scientific computation and visualisation package may also be used. SCILAB is available to download for free at www.scilab.org

COURSE DETAIL

S.No	Topics	No. of Hours
1	**Introduction** Motivation and applications.	1
2	**Computation and Error Analysis** Accuracy and precision; Truncation and round-off errors; Binary Number System; Error propagation.	2
3	**Linear Systems and Equations** Matrix representation; Cramer's rule; Gauss Elimination; Matrix Inversion; LU Decomposition; Iterative Methods; Relaxation Methods; Eigen Values.	6
4	**Algebraic Equations** Bracketing methods: Bisection, Reguli-Falsi; Open methods: Secant, Fixed point iteration, Newton-Raphson; Multivariate Newton's method.	5

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Chemical Engineering

Hyperlinks:

Numerical Recipes in Fortran and C:

www.nr.com

Coordinators:

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5	**Regression and Curve Fitting** Linear regression; Least squares; Total Least Squares; Interpolation; Newton's Difference Formulae; Cubic Splines.	5
6	**Numerical Differentiation** Numerical differentiation; higher order formulae.	3
7	**Integration and Integral Equations** Trapezoidal rules; Simpson's rules; Quadrature.	4
8	**ODEs: Initial Value Problems** Euler's methods; Runge-Kutta methods; Predictor-corrector methods; Adaptive step size; Stiff ODEs.	8
9	**ODEs: Boundary Value Problems** Shooting method; Finite differences; Over/Under Relaxation (SOR).	3
10	**PDEs** Introduction to Partial Differential Equations.	4
	Total	41

References:

1. Gupta S.K. (1995) Numerical Methods for Engineers, New Age International.
2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed; McGraw Hill.