MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate its use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed.

The objective of this course is to introduce undergraduate students to computational methods using MATLAB. At the end of this course, a student would:

- Learn basics of MATLAB programming
- Get introduced to numerical methods for engineering problems
- Will be able to use MATLAB to solve computational problems

Pre-requisites:
The students for this course are expected to know basics of linear algebra and calculus. These are covered in Introductory Math course(s) for Engineers (typically done in first year).

This is intended to be practical (laboratory) course. Some prior background in programming will be useful, though not required. Likewise, students who have either completed or are currently doing “Numerical Methods”/“Computational Techniques” will find it easier to follow this course. Theoretical aspects of methods covered in this lab can be found in NPTEL course on “Computational Techniques” (http://nptel.ac.in/courses/103106074/).

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5. Module 5: Nonlinear Equations
   After introduction to bisection rule, this module primarily covers Newton-Raphson method and MATLAB routines fzero and fsolve.
   Lecture 5-1 Nonlinear equations in single variable
   Lecture 5-2 MATLAB function fzero in single variable
   Lecture 5-3 Fixed-point iteration in single variable
   Lecture 5-4 Newton-Raphson in single variable
   Lecture 5-5 MATLAB function fsolve in single and multiple variables
   Lecture 5-6 Newton-Raphson in multiple variables

6. Module 6: Regression and Interpolation
   The focus will be practical ways of using linear and nonlinear regression and interpolation functions in MATLAB.
   Lecture 6-1 Introduction
   Lecture 6-2 Linear least squares regression (including lsqcurvefit function)
   Lecture 6-3 Functional and nonlinear regression (including lsqnonlin function)
   Lecture 6-4 Interpolation in MATLAB using spline and pchip

7. Module 7: Ordinary Differential Equations (ODE) – Part 1
   Explicit ODE solving techniques in single variable will be covered in this module.
   Lecture 7-1 Introduction to ODEs; Implicit and explicit Euler’s methods
   Lecture 7-2 Second-Order Runge-Kutta Methods
   Lecture 7-3 MATLAB ode45 algorithm in single variable
   Lecture 7-4 Higher order Runge-Kutta methods
   Lecture 7-5 Error analysis of Runge-Kutta method

8. Module 8: Ordinary Differential Equations (ODE) – Practical aspects
   This module will cover ODE solving in multiple variables, stiff systems, and practical problems. The importance of ODEs in engineering is reflected by the fact that two modules are dedicated to ODEs.
   Lecture 8-1 MATLAB ode45 algorithm in multiple variables
   Lecture 8-2 Stiff ODEs and MATLAB ode15s algorithm
   Lecture 8-3 Practical example for ODE-IVP
   Lecture 8-4 Solving transient PDE using Method of Lines

References:
Textbook:

Reference Book:

Related NPTEL Video Courses:
Computational Techniques:
http://nptel.ac.in/courses/103106074/

Numerical Methods and Programming:
http://nptel.ac.in/courses/122106033/