

EAS 105
An Introduction to Scientific Computing
Towne 311

Overview: This course will provide an introduction to computation and data analysis using MATLAB - an industry standard programming and visualization environment. The course will cover the fundamentals of computing including; variables, functions, flow control, iteration and recursion. These concepts will be illustrated through examples and assignments which show how computing is applied to various scientific and engineering problems. Examples will be drawn from the simulation of physical and chemical systems, the analysis of experimental data, Monte Carlo numerical experiments, image and audio processing, and the control of sensors and actuators.

Prerequisites: This course does not assume any prior programming experience but will make use of basic concepts from calculus and Newtonian physics.

Textbook: Introduction to Scientific Computation and Programming – Daniel Kaplan

Assignments and Examinations: The course will consist of two lectures and one hour of computer lab a week. Homework projects will be assigned and collected weekly. There will be two midterm and one final examination.

Topics:

- Fundamentals of Computing: (3 weeks)
 - o Variables, expressions, functions, arrays, flow control iteration, recursion, m-files and scripts. All programming concepts will be illustrated using Matlab's interactive programming and debugging environment.
- Visualization (1 week)
 - o Plots, bar-graphs, histograms, contour and surface plots.
- Simulation of Physical Systems (3 weeks)
 - o Simulating the behavior of mechanical, chemical and biological systems governed by simple ODEs. Numerical integration using Euler's method. Simulation of simple systems with feedback control.
- Analysis of Data (2 weeks)
 - o Importing and analyzing experimental and other data presented in tabular form. This section will involve writing programs to answer various questions about given datasets.
- Linear Systems (2 weeks)
 - o This section will describe how to use Matlab to solve various practical problems involving systems of linear equations such as those arising from force balance equations.
- Monte Carlo Methods (1 week)
 - o This section will briefly show how methods involving randomization, such as monte carlo integration, can be used to carry out various scientific computations

Applications (2 Weeks)

- o Interfacing to Sensors and Actuators
 - . Computers are commonly used to control modern electromechanical systems. This module will provide an introduction to how computers are used in this context and will involve using Matlab to guide the actions of a simple robotic system.