MSE 350 - Numerical Methods in Materials Science and Engineering

Designation: Required

2012-2013 catalog description: Fundamentals of high-level scientific and engineering computing using the Python programming language, including a broad introduction to numerical methods with applications to materials science and engineering. [3 units offered in the Fall]

Prerequisites Vector calculus, differential equations.

Textbook: None. Course materials are on the course website, and use is made of the online version of Dive Into Python, (M. Pilgrim, CreateSpace, Paramount, CA, 2009.) as well as the documentation and tutorials on SciPy.org.


Topics Covered:
- Programming fundamentals
- Overview
- Flow control
- Loops
- Input/Output
- Concepts related to object-oriented programming
- Arrays, array operations, and universal functions (ufuncs)
- Scientific Visualization
- Line and scatter plots
- Contour plots
- Vector plots
- Numerical methods, with case studies in MSE
- Solution of linear systems
- Numerical quadrature
- 1-D interpolation
- Numerical root-finding, including solution of systems of nonlinear systems
- Nonlinear optimization
- Nonlinear curve-fitting and parameter estimation
- Solution of ordinary differential equations
- Solution of partial differential equations using the finite-difference technique

Computer Usage: The entire course focuses on writing computer programs, so computer usage is extensive. Many assignments require internet research to discover existing functionalities.

Contribution to 25 % Math & Basic Sci. 1 credits Math & Basic Sci.
Criterion 5: 15 % Engr. Science 2 credits Engr. Topics
60 % Engr. Design

Person preparing syllabus and date: Robert Erdmann, Feb. 2010