Course Description for CES Required Courses

**CS 6210 Advanced Scientific Computing I (3) (Fall)**
Prerequisite: CS 3200 and 3510 and MATH 3160. Meets with CS 5210. An introduction to existing classical and modern numerical methods and their algorithmic development and efficient implementation. Topics include numerical linear algebra, interpolation, approximation methods and parallel computation methods for nonlinear equations, ordinary differential equations, and partial differential equations. Graduate students only.

**CS 6220 Advanced Scientific Computing II (3) (Spring)**
Prerequisite: CS 5210/6210 or MATH 5600. A study of the numerical solution of two- and three-dimensional partial differential equations that arise in science and engineering problems. Topics include finite difference methods, finite element methods, boundary element methods, multigrid methods, mesh generation, storage optimization methods, and adaptive methods.

**CS 6630 Scientific Visualization (3) (Fall)**
Prerequisite: CS 3510 and (3200 or 5210/6210 or MATH 5600). Meets with CS 5630. Graduate students only. Extra work required. Introduction to the techniques and tools needed for the visual display of data. Students will explore many aspects of visualization, using a "from concepts to results" format. The course begins with an overview of the important issues involved in visualization, continues through an overview of graphics tools relating to visualization, and ends with instruction in the utilization and customization of a variety of scientific visualization software packages.

**CS 5610 Introduction to Numerical Analysis I (4) (Fall)**
Prerequisite: MATH 2210, either MATH 2250 or 2270 and computing experience. Meets with MATH 6860.
Numerical linear algebra, interpolation, integration, differentiation, approximation (including discrete and continuous least squares, Fourier analysis, and wavelets).

**CS 5620 Introduction to Numerical Analysis II (4) (Spring)**
Prerequisite: MATH 5610. Meets with MATH 6865. Numerical solution of initial and boundary value problems of ordinary and partial differential equations.

**Math 5740 Mathematical Modeling (3) (Spring)**
Prerequisite: MATH 5600 or CS 5220. Meets with MATH 6870. Development of mathematical models for physical, biological, engineering, and industrial phenomena and problems, using mainly ordinary and partial differential equations. Involvement of analytical and numerical tools suitable for analysis and visualization of the solutions of these problems, including packages such as LINPACK, EISPACK, Maple and Matlab.

**Math 6790 Case Studies in Computational Engineering and Science (3) (Spring)**
Prerequisite: MATH 5740. Two to five faculty members from various disciplines will describe in detail a project in which they are engaged that involves all ingredients of computational engineering and
science: a scientific or engineering problem, a mathematical problem leading to mathematical questions, and the solution and interpretation of these questions obtained by the use of modern computing techniques. Participating faculty will vary from year to year. To be offered on the basis of need.

**Math 6795 (or CS 6938) Seminar in Computational Engineering and Science (1 to 5) (To be offered on the basis of need)** Prerequisite: MATH 6790. Students in the final semester of the Computational Engineering and Science Program will present their own CES-related research.

*Further detail is provided in the FAQ section*

**PHYCS 6720 Introduction to Computing in Physics (4) (Fall)**
Meets with PHYCS 3730.
Brief introduction to computing tools for science and engineering work on modern workstations. Topics include Unix (file structures, commands, scripts, etc.), editing (especially with emacs), spreadsheets, technical document preparation (LaTeX, Postscript), symbolic manipulation (Maple), use of library routines (LAPACK), Programming in C++, and organizing large codes with makefiles. These tools will be illustrated by applying them to scientific and engineering problems.

**PHYCS 6730 Computational Physics 2 (4) (Spring)**
Recommended Prerequisite: MATH 3150 and 3160 and either PHYCS 3730, 6720 or CS 3200.
Survey of modern numerical methods with programming exercises in C++ and Maple on Unix workstations. Topics include root finding, solving linear systems by direct and iterative methods, eigenvalue problems, interpolation and extrapolation, differentiation and integration, solution of ordinary and partial differential equations, elementary statistics, linear and nonlinear optimization, Fourier transforms.