**Phys 370 - Introduction to Computational Physics - 3 credits**

Bulletin Description:

Introduction to computational methods, with applications to planetary motion, numerical integration, chaotic oscillations, percolation, random walks, diffusion limited aggregation, molecular dynamics simulation, Monte Carlo methods, and Fourier transforms. 2 lectures, 2 one-hour laboratories. Prereq: PHYS 251, MATH 166 and CSCI 160 or ECE 173. Coreq: PHYS 252.

Course Objectives:

Computational tools have become an integral component in almost all areas of physics. This course introduces students to some of the most important computational tools, which will allow them to extend their explorations of physics beyond the small set of analytically accessible problems that they were able to solve using the methods taught in the introductory courses. The course also acts as an introduction to independent research by requiring the students to select and perform a project and present their results both in a paper and a presentation.

Content Listing:

- Introduction to a computational environment that allows students to write programs, visualize and analyze their results, write scientific publications, and give presentations
- Solution of Newton's equations using the Euler algorithm
- Examination of numerical properties of the Euler algorithm and introduction to the Verlet algorithm
- Application to oscillatory systems and planetary motion
- Chaos and dynamical systems
- Random processes: random walks, nuclear decay, polymer conformations
- Molecular dynamics simulation
- Monte Carlo methods

Additional Optional Content:

- Electrostatics and dynamics
- Lattice Gas and Lattice Boltzmann methods
- Applications to fluid flow: turbulence, multiphase, multicomponent flows
- Fluctuations
- Fractals and kinetic growth: fractal dimension
- Colloidal dynamics
- Rigid body motion