Physics 370 **Spring 2017**

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.

Instructor: Alexander Wagner
South Engineering 210
231-9582
Alexander.Wagner@ndsu.edu
http://www.ndsu.nodak.edu/physics/people/faculty/wagner.htm

Meetings: 9:00-10:45 Tu & Th, South Engineering 221
Office Hours: Wednesday 11-12am and by arrangement
Texts: Alexander Wagner
Computational Physics lecture notes
Optional: Harvey Gould, Jan Tobochnik, Wolfgang Christian
An introduction to Computer Simulation Methods
Third Edition, Pearson/ Addison Wesley

Topics:

week 01	Introduction to linux/ programing background/ graphics/ discrete examples/ writing LaTeXdocuments.
week 02	Discrete dynamics, chaos, fractals
week 03	Continuous motion: solving Newton's equations, Euler and Verlet algorithms
week 04	The $1/r^2$ force law: Planetary dynamics, simulating the solar system, predicting eclipses etc.
week 05	The Lenard Jones potential: periodic boundary conditions, Molecular Dynamics (MD). Measuring velocity distribution/pressure.
week 06	The Monte Carlo algorithm: examining the Lennard Jones particle system again.
week 07	Using MD to look at hydrodynamics.
week 08	Lattice gases for hydrodynamics, viscosity, sound and shock waves.
week 09	Boltzmann analysis of lattice gases
week 10	Lattice Boltzmann methods
week 11	Determining students projects
week 12-14	Discussion of student project issues
week 15	Finalizing student Project papers and presentations

Schedule: There will be a Midterm and a final. Student projects are very flexible and fully dependent on the student's interests. Subjects of past projects include sound waves, turbulent flows, boiling simulations, phase-separation, evaporation, rocket launch simulations, predictions of transits of venus, and many others.

Grading: Problems 25%, Midterm 25%, Participation 10%, Projects 40%
A:90% – 100 %; B:80% – 89 %; C:60% – 79 %; D:40% – 59 %; F:0% – 40 %

- *Any students with disabilities who need accommodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.*
- *All work done in this course must be completed in a manner consistent with NDSU University Senate Policy, section 355: Code of Academic Responsibility and Conduct (http://www.ndsu.nodak.edu/policy/355.htm)*