Syllabus for PHY 315.
Computational Physics and Complexity

PHY315 Computational Physics and Complexity (3) Corequisites: PHY 321 or MAT 361. Introduction in the use of numerical modeling techniques for solving problems in physics and complex systems. Topics that will serve as the means for applying learned numerical techniques include classical mechanics; bifurcation and dynamical systems; chaotic systems; thermodynamics; optimization; cellular automata; self-organization.

A. Instructor: Professor Dylan E McNamara

B. Goals: This course will provide an introduction to the applicability and use of computers in solving a range of problems in the field of physics and complex systems. Initially students will be instructed on the use of numerical modeling software and then topics within the field will be used as a context for learning and applying numerical techniques to solve physics problems.

C. Resources: Liberal use of the internet.

D. Course Prerequisites or Restrictive Statements: Corequisites: PHY 321 or MAT 361

E. General Education Requirements: None

F. Student Learning Outcome: Course lays the foundation for applying numerical computation techniques in solving physics problems.

G. Textbooks:
Steven C Chapra. Applied Numerical Methods with MATLAB for Engineers and Scientists. McGraw-Hill Science Engineering. Hardbound, 588 pages, publication date: NOV-2006; ISBN-10: 007313290X; ISBN-13: 9780073132907; $112.95.

H. Course Organization and Scope:

Course is based on applying numerical computation techniques for solving problems in physics and complex systems.

Section 1: Introduction to Matlab
- 1.1 Vector and Matrix Assignment
- 1.2 Mathematical Operations
- 1.3 Functions
- 1.4 Programming
- 1.5 Graphics

Section 2: Classical Mechanics

2.1 Numerical Solution of ODEs
2.2 Simple Harmonic Oscillator

Section 3: Dynamical Systems
3.1 Advanced ODE methods
3.2 Population Models / Spread of Disease

Section 4: Deterministic Chaos
4.1 Lorenz System
4.2 Chaotic Time Series Forecasting

Section 5: Thermodynamics
5.1 Numerical Solution of PDEs
5.2 Heat Equation
5.3 Reaction Diffusion Equations

Section 6: Optimization
6.1 Simmulated Annealing
6.2 Genetic Algorithms
6.3 Neural Networks

Section 7: A New Kind of Science
7.1 Cellular Automota
7.2 Irreversibility
7.3 Conservation Laws

Section 8: Self-Organization.
8.1 Heirarchical Modeling
8.2 Granular Dynamics
8.3 Sediment Transport

I. Projected schedule for reading assignments: There will be reading assignments to follow the assigned text as well as assigned readings from the scientific literature.

J. Grading:

HW Assignments	400
FINAL PROJECT	100
Final Grade Bases on % of	500 points

Final grades will be based on a plus/minus grading scale as follows: A = 93-100; A- = 90-92; B+ = 87-89; B = 83-86; B- = 80-82; C+ = 77-79; C = 73-76; C- = 70-72; D+ = 67-69; D = 63-66; D- = 60-62; and F < 60.

K. Late Assignments:

- Extensions for late assignments will be granted individually in consultation with the professor under extenuating circumstances.

L. Absences and Scheduling Makeup Work:

- Attendance is highly recommended.
- Absences from tests will result in a zero being registered for that test except for excused absence. If you miss a test due to an excused absence, it will be the responsibility of the student to make arrangements with the professor for a makeup exam.
- Excused Absence: Case of illness documented with a note from a doctor or (when presented before the scheduled class period) officially sanctioned university activities that conflict directly with the class time or when excused from class by the professor prior to the scheduled class period.

M. Statement on Academic Integrity:

- University Policy on Academic Integrity: The instructor of this course is committed to upholding the University policy on academic integrity, described in the Code of Student Conduct, which can be found at: http://www.uncw.edu/policies/04-100-academichonorcode.htm
- Faculty Expectation: The instructor of this course is committed to upholding the University policy on academic integrity.

N. Statement for students with disabilities:

- Students with disabilities are invited to schedule an appointment with the instructor to discuss any needed accommodations. Reasonable accommodations will be made for students with verifiable disabilities.
- In order to take advantage of available accommodations, students must present documentation to Disability Services for Students at Westside Hall, First Floor, Phone: 910-962-7555 - Fax: 910-962-7556 - TDD: 910-962-3853.

  http://www.uncw.edu/stuaff/disability/contact.htm
- For more information on UNCW's policy on working with students with disabilities, please see

  http://www.uncw.edu/stuaff/disability/contact.htm

O. Statement on laboratory safety or risk assumption:

- Any laboratory work associated with this course has no special risks that would make it less safe than any other classroom. The Department of Physics and Physical Oceanography is committed to maintaining an environment in which students can safely pursue their required laboratory assignments.

P. UNCW Policy on violence and harassment: UNCW practices a zero-tolerance policy for violence and harassment of any kind. For emergencies contact UNCW CARE at 962-2273, Campus Police at 962-3184, or Wilmington Police at 911.

For University or community resources visit:
http://uncw.edu/wrc/crisis.htm

Q. Statement on extra expenses: There are no significant extra expenses.

R. Statement on transportation: There will be no additional transportation costs associated with this course.