September.2010

Physics 2820
Computational Mechanics

Instructor: Brad de Young

Physics and Physical Oceanography
Memorial University,
bdeyoung@mun.ca
Room C-3000
737-8738

PHYS 2820 Computational Mechanics: Newtonian and gravitational dynamics, data analysis, statistics, numerical differentiation and integration, numerical solutions to mechanics problems and vibrations, linear and non-linear oscillators.

The goal of this course is to integrate computational techniques with some fundamental classical mechanics. The course will therefore interweave computational techniques with mechanics by having students work with computers during the laboratories and in assignments. We will work with the programming language *Mathematica* to solve the mechanics problems that we explore. We will use Macs during class but the numerical analysis can be performed on any platform.

Announcements about the course, class notes, assignments and various other goodies will be available from the course web page.

Activity:

Assignments (including in-class work)	40 %
Test – mid-term	20 %
Final examination	40 %

Course outline

1) Approaches to computational physics, introduction to *Mathematica* and computers

2) Reexamining some first year physics problems, pendulums, projectile motion, central forces

3) Numerical integration and differentiation, plotting and defining functions

4) Forces, inertia, Newton's Law – motion in two dimensions, curvilinear motion, charged particles in a magnetic field, viscosity and drag resistance, simple harmonic motion, simple pendulum.

5) Integrating dynamical equations and gravitational theory. Solving projectile motion problems, Eulers method, accuracy, numerical stability, leap-frog method, predictor corrector method, Runge-Kutta techniques, orbits planets and comets:

6) Free and forced vibrations - pendulums, decay of free vibrations, complex exponentials, forced oscillations with damping, electrical resonance (Chapters 4 and 5 in French Vibrations and Waves).

7) Working with numbers on computers, linear least squares, root finding, curve fitting

Texts :

We will use the text by Boccara, Nino – *Essentials of Mathematica* (2007) which is available as an e-book through the library. We will use your first year physics text as the reference for the mechanics that we discuss.

The software required for the course, Mathematic, is required and can be purchased through the Computer Purchasing Centre (CPC – next to the Science building), for about $30.

Classes: Tues and Thursday in C-2045 from 10:30 to 11:50. The labs are in C-2039 on Tuesday from 3:30 to 5:00.

Schedule – note that we can adjust this schedule if we all agree to do so but this will give you an idea of how things should go.

Assignments will be set out roughly every two weeks and due ten to twelve days later:

Assignment 1 – Out 14 September
Due 21 September

Assignment 2– Out 21 September
Due 30 September

Assignment 3 – Out 5 October
Due 14 October

MidTerm Test – 21 October

Assignment 4 – Out 25 October
Due 4 October

Assignment 5 – Out 4 October
Due 16 October

Assignment 6 - Out 18 October
Due 30 November