

Instructor and Hours

Lectures	:	Mon Wed Fri, 5:00–5:50 pm, 14 Knox
Websites	:	http://ublearns.buffalo.edu/ http://www.physics.buffalo.edu/phy410-505/
Instructor	:	Dr. Richard Gonsalves
Office Hours	:	Tu 11:00–12:00, or by appointment (323 Fronczak Hall)
Phone	:	(716) 645-2017 ext. 191
Email	:	phygons@buffalo.edu

Course Description

This course integrates the elements of numerical analysis and computer programming to study a variety of problems in classical, quantum, and statistical physics. The course will cover basic numerical operations: root finding, interpolation, matrix inversion, numerical differentiation, and quadrature. Numerical techniques will include solution of ordinary linear and nonlinear differential equations of classical and quantum physics, boundary-value and eigenvalue problems, statistical analysis of data, the Fast Fourier Transform, and computer graphics. Application programs will be developed in pseudocode and implemented in C++, a powerful objected oriented language which will be the official language for this course. Some discussion of other languages (Fortran, Java, Mathematica, Maple) may be included depending on time available and student interest.

Learning Outcomes

After completing the first semester of this course you should have mastered elementary algorithms for basic numerical operations, solution of ordinary differential equations, linear algebra, data analysis and random sequences. You should be able to design correct codes (of a few hundred lines) and to perform simulations of simple but realistic physical systems. You should be able to run your codes, analyze the output, and present your results in a form suitable for scientific publication.

Course Requirements

This course will assume familiarity with classical mechanics, electrodynamics, and thermal physics at the undergraduate level. Familiarity with a programming language will be helpful, but is not required. If you are not familiar with C++ will need to learn to use it by understanding and modifying the code examples, which will be explained in detail in lecture. If you wish to use another language for good reasons, I am willing to discuss the possibility with you.

The required textbook for this course is *Computational Physics*, 2nd Edition, by Giordano and Nakanishi (Pearson Prentice Hall, 2006) ISBN 0-13-146990-8. It is available at the University Bookstore and on reserve at the Library. Chapters 1–7 will be covered in Fall 2008. Chapters 8–12, and additional special topics, will be covered in Spring 2009.

A very useful online reference for this course will be the *Numerical Recipes* books by Press, Teukolsky, Vetterling, and Flannery. Fortran and C versions of these books are available for free online. Additional online references on specific topics will be provided in lecture.

You will need access to a computer running a recent version of Windows, Mac OS X, or Linux. All software required for this course is available for free. Student versions of Mathematica and Maple and other useful software packages are available from UBMicro at very nominal cost.

Homework Assignments

There will be a homework assignment due each week before 5:00 pm on the due date. Late homework, without a valid excuse, will be penalized at the rate of 20% per day overdue. Graduate students will be given some more difficult assignments based on graduate-level physics. Your assignment may be hand-written or typeset using a word-processing program. Assignments may be printed and submitted in class, or emailed to me as a PDF file. Only one submission of your complete assignment is allowed. Homework assignments will count for 50% of your final grade.

Examinations

There will be a mid-term exam (in class on Friday, October 17), and a final exam (to be scheduled during the final exam period). These tests will consist of short questions and problems based on the lecture material and the homework assignments. PHY 410 and 505 will have different exams. The mid-term exam will count for 15% and the final for 25% of your grade. Exams will be closed book, but you can bring with you an $8\frac{1}{2}'' \times 11''$ formula sheet.

Class Participation

Credit counting for 10% will be give for class participation, which may include completing brief pre-class and in-class assignments.

Letter Grades

An aggregate numerical grade of at least 50% will be required to pass this course. PHY 410 and 505 students will be assigned letter grades on separate curves. In past semesters the cutoff for an A grade has been approximately 85%.

If you maintain a passing average on the midterm exams and homework but miss the final exam with a valid excuse, you may request an Incomplete (I) grade for the course. Incomplete work must be made up when the course is offered again, and before the default deadline.

Resignation

The last day to drop this course without financial liability is Friday August 29, 2008. The last day to drop this course without an "R" grade is Friday September 5, 2008.

If you find that you are failing the course, or if you wish to withdraw from the course for any reason, you may resign with an "R" grade on or before Friday, November 7, 2008.

Academic Integrity

Academic integrity is a core value underlying all scholarly activity in the Department of Physics. Please review UB policy on academic integrity at <http://undergrad-catalog.buffalo.edu/policies/course/integrity.shtml> (undergraduates) and http://www.grad.buffalo.edu/policies/academic_integrity.pdf (graduate students).

You are encouraged to discuss class material and assignments with your colleagues. However, you should code and run your simulations yourself, and your homework writeup must be entirely your own effort. If you copy and/or modify code from any source for your assignments you should acknowledge this with an appropriate citation in your writeup.

Students with Disabilities

If you have a disability, (physical or psychological) and require reasonable accommodations to enable you to participate in this course, such as note takers, readers, or extended time on exams and assignments, please contact the Office of Disability Services, 25 Capen Hall, 645-2608, <http://www.student-affairs.buffalo.edu/ods/>, and also see me during the first two weeks of class. ODS will provide you with information and review appropriate arrangements for reasonable accommodations.