Physics 317-Introduction to Computational Physics
Spring 2008

Dr. Michael Bromley
Dr. Fridolin Weber

San Diego State University

Administrative Information

About the course: Physics 317 is a computational physics course required by all physics majors. In this class you will learn how to tackle a variety of physics problems using numerical techniques which should add to your knowledge of physics as well as providing you with computational methods that will be useful in solving other problems. The computer language that you will learn is Fortran 77/90/95. The Fortran language is one of the oldest and most updated languages in use by the engineering and scientific communities. Even its name comes from its intended purpose, FORmula TRANslation. Fortran 90 was updated to Fortran 95, providing one of the best if not the best programming language for solving problems in the physical sciences and engineering disciplines. While learning FORTRAN you will be using Intel and GNU Fortran on Linux (a UNIX like operating system) based PCs.

The expected outcomes of this course: This course is an introductory course into computational physics. At the end of the course you should be able to write programs in Fortran to solve simple physics based problems (involving matrices, root finding, numerical integration, numerical differentiation, differential equations) and to output results in graphical form using appropriate numerical programs. You will have been made aware of a number of methods in numerical analysis, and of some of the problems encountered in solving problems numerically (e.g. numerical stability, rounding errors).

Instructors: Dr. Fridolin Weber (22 January to 6 March)
Dr. Michael Bromley (11 March to 8 May)
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Email: fweber@sciences.sdsu.edu; mbromley@physics.sdsu.edu
Office: P 142 (Weber), P 139 (Bromley)
Office Hours: Tuesday and Thursday from 11:30 AM-12:30 PM
Lectures/Lab: Tuesday and Thursday from 12:30-3:10 PM
Location: P 247

Textbook: No textbook is required for this class. An optional textbook is *"Structured Fortran 77 for Engineers and Scientists"* (5th edition), by Delores M. Etter, Wiley Publishing, ISBN: 0-201-49854-5, Paperback, 672 pages. Because of the significant diversity in topics to be covered, I will frequently distribute hard copies of the material covered in class. For testing purposes, you will be responsible for the material covered in class and homework assignments. For those of you who anticipate doing futher numerical work, I recommend the book "*Numerical Recipes*," by Press et al. Which can be downloaded for free at http://www.library.cornell.edu/nr.

Grades: The final grade weighting for this course will be as follows:

Homework: 20%
Each midterm exam: 25%
Final exam: 30%

The letter grade scale is as follows: A+ >95%, A >90%, A- >85%,
B+ >80%, B >75%, B- >70%,
C+ >65%, C >60%, C- >55%,
D+ >50%, D >45%, D- >40%,
F <40%

Assignments: Homework problem sets will be assigned usually on Tursday, and are due at the start of class the following Thursday. Homework must be computer written/printed and stapled or submitted electronically, as required by the assignment. At the discretion of the instructor, loose, torn, crumpled or soiled work may not be accepted. Each student is required to produce independent, original homework solutions.
Note: Assignments must be turned in on time. Work turned in late will be marked down by 20% each day.

Exams: There will be two midterm exams and a final exam. The **midterms** will be on

March 4, from 12:30-2:00 PM in room P 247,
April 15, from 12:30-2:00 PM in room P 247.

The **final** will be on

May 13, from 1:00-3:00 PM in room P 247.

There will be no makeup exams. All exams are closed book.

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Approximate course outline

I. Introduction to Unix

1. Basic commands
2. Editors
3. Compilers

II. Introduction to Fortran

1. Structure of Fortran programs
2. IF statement
3. Reading Data
4. DO loops
5. Subroutines, Functions, Common Blocks
6. Arrays
7. Reading files
8. Fortran 90 standard

III. Numerical applications

1. Least square methods
2. Numerical integration
3. Numerical differentiation
4. Matrix operations
5. Finding roots
6. Solving ordinary differential equations

The following topics will be studied numerically:

- Bacteria growth
- Analysis of earthquake data
- Motion of weather balloons
- Projectiles in viscous media
- Motion of comets and satellites
- Mass formula of atomic nuclei
- Sonar signal
- Radioactive decay
- Planck's radiation law
- Rocket equation
- Particle motion under the action of time-dependent forces