

## COURSE ORGANIZATION

- On the average, one meeting per week will be a lecture presentation, the second meeting will consist of programming exercises in a computer lab.
- Programming exercises shall be in FORTRAN and/or in C, with use of a library of standard mathematical routines. The methods presented in the lecture shall find application in the assigned programming projects.
- Accounts will be on a UNIX platform through network access.
- Basic skills like the use of simple shell commands (cd, ls, pwd, ...), editors (vi, nedit, emacs, ...), file manipulations (tar, gzip, scp, ...), and a working knowledge of a programming language shall be acquired during (or prior to) Part I of the course. For Part II of the course the mastering of programming will be indispensable.
- Graphics packages (gnuplot, physica, ...) shall be used to visualize computed results as part of the programming exercises.
- Physics programming projects will be assigned. Significant portions of those should be done during the computer lab sessions. Error free running code, and/or files, shall be submitted as part of the course requirement; the fractional return, in combination with exam results, will be used to determine the final grade for the course.
- There will be one final exam consisting of projects assignments to be done during a standard class period in the computer lab.
- *Tentative* exam schedule, Spring 2012  
Apr-25 (Wed)
- Course material (example code, data files, instructions, handouts, programming assignments, etc) will be put into

`file:///USER@oughtred.fiu.edu/home/phz5156/`

with read permission for the class.

- The course outline below loosely follows:  
Computational Physics *Problem Solving with Computers*, by R. H. Landau, M. J. Páez Mejiá A, John Wiley & Sons Inc, New York, 1997.  
Computation in Modern Physics, by W. R. Gibbs, World Scientific, Singapore, 1994.  
However, deviations, additions, supplements, etc, should be expected. See a list of suggested literature below.
- Announcements made in class may supersede syllabus rules!

## COURSE OUTLINE - PART I

- I.1 NUMERICAL INTEGRATION
  - Extended formulae
  - Gaussian quadrature
- I.2 BASIC MONTE CARLO
  - Markov chains
  - Metropolis algorithm
  - Error estimation

- I.3 DIFFERENTIAL METHODS
  - Simple discretization
  - Runge Kutta algorithms
- I.4 LINEAR ALGEBRA METHODS
  - Gauss-Jordan elimination
  - LU-decomposition
  - Householder transformation
  - Diagonalization
  - Jacobi rotations
  - Singular value decomposition

## COURSE OUTLINE - PART II

- II.1 CHAOS
- II.2 FOURIER TRANSFORMATION
- II.3 FINITE ELEMENT METHODS
- II.4 SIMULATED ANNEALING
- II.5 QUANTUM SCATTERING
- II.6 MANY-BODY SYSTEMS
- II.7 NUMERICAL SIMULATION OF FIELD THEORIES
- II.8 INTRODUCTION TO PARALLEL COMPUTING

## ONLINE MATERIAL

The programming exercises are in (Note: All links below might change due to installation of computer equipment.)

- <file:///USER@oughtred.fiu.edu/home/phz5156/>

For computer related reference material (operating system, programming languages, etc) and links to mathematical libraries point your browser at:

- <file:///USER@oughtred.fiu.edu/home/phz5156/compdoclinks.html>
- <file:///USER@oughtred.fiu.edu/home/phz5156/mathliblinks.html>

The SLATEC library documentation is in:

- <file:///USER@oughtred.fiu.edu/home/phz5156/slatec/gams.html>
- <file:///USER@oughtred.fiu.edu/home/phz5156/slatec/toc.html>

## SUPPLEMENTARY REFERENCES (strongly suggested)

- Unix for the Impatient, by Paul W. Abrahams, Bruce Larson, Paperback - 824 pages 2nd edition (September 1995), Addison-Wesley Pub Co; ISBN: 0201823764
- Running Linux, by Matt Welsh, Matthias Kalle Dalheimer & Lar Kaufman, 3rd Edition August 1999, 1-56592-469-X, 752 pages,
- Fortran 77 for Engineers and Scientist, by Martin O. Holoiien, Ali Behforooz, Paperback 2nd edition (May 1991), Brooks/Cole Pub Co; ISBN: 0534141668
- Practical C Programming, by Steve Oualline, 3rd Edition August 1997, 1-56592-306-5, 454 pages

- Numerical Recipes in Fortran 77 : The Art of Scientific Computing by William H. Press, Saul A. Teukolsky (Contributor), William T. Vetterling, Brian P. Flannery (Contributor), Hardcover - 963 pages 2nd edition (October 1992), Cambridge Univ Pr (Short); ISBN: 052143064X
- Numerical Recipes in C : The Art of Scientific Computing by William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Hardcover - 994 pages 2nd edition (January 1993), Cambridge Univ Pr (Short); ISBN: 0521431085

#### SUPPLEMENTARY REFERENCES (random selection)

- Linux in a Nutshell, by Ellen Siever & the Staff of O'Reilly & Associates, 2nd Edition February 1999, 1-56592-585-8, 628 pages
- Learning the Unix Operating System , by Jerry D. Peek, Grace Todino, John Strang, Paperback - 92 pages 4th edition (December 1997) , Reilly & Associates; ISBN: 1565923901
- An Introduction to Fortran for Scientific Computing, by James M. Ortega, Hardcover (January 1994), Hbj College & School Div; ISBN: 0030031281
- Programming With Fortran (Schaum's Outlines), by Seymour Lipschutz, Paperback (September 1977) , McGraw-Hill; ISBN: 007037984X
- Introduction to Fortran (Harcourt Brace Jovanovich College Outline Series), by Charles B. Kreitzberg, Norman T. Carpenter, Paperback - 211 pages 1st Ed. edition (January 1991), Hbj College & School Div; ISBN: 0156000369
- The Essentials of FORTRAN (Essentials), by D. Rev. Smorlarski, Paperback (May 1989), Research & Education Assn; ISBN: 0878916636
- Effective Fortran 77, by Michael Metcalf, out of print
- Fortran 90/95 Explained, by Michael Metcalf, John Ker Reid , Paperback 2nd edition (August 1999), Oxford Univ Press; ISBN: 0198505582
- Practical C++ Programming, by Steve Oualline, 1st Edition September 1995, 1-56592-139-9, 584 pages
- Numerical Recipes in Fortran 90 : The Art of Parallel Scientific Computing (Fortran Numerical Recipes , Vol 2), by William H. Press (Editor), Saul A. Teukolsky (Contributor), Michael Metcalf, Hardcover 2nd edition Vol 2 (September 1996), Cambridge Univ Pr (Short); ISBN: 0521574390
- A Practical Guide to Splines, by Carl de Boor, Applied Mathematics Series 27, Springer-Verlag, New York, 1978.

#### SUPPLEMENTARY REFERENCES (computational physics)

- Computational Physics *Problem Solving with Computers*, by R. H. Landau, M. J. Páez Mejiá A, John Wiley & Sons Inc, New York, 1997.
- Computation in Modern Physics, by W. R. Gibbs, World Scientific, Singapore, 1994.
- A First Course in Computational Physics, by Paul L. DeVries, John Wiley & Sons Inc, New York, 1994.
- An Introduction to Computational Physics, by Tao Pang, Cambridge Univ Press, Cambridge, 1997.
- Computational Physics, by J M Thijssen, Cambridge Univ Press, Cambridge, 1999.
- Computing for Scientists *Principles of Programming with Fortran 90 and C++*, R. J. Barlow, A. R. Barnett, John Wiley & Sons Inc, Chichester, 1998.