

COMPUTATIONAL METHODS IN PHYSICS AND ENGINEERING

Syllabus and Course Outline

- Instructors: Dr. Richard O. Gray, lecture email: grayro@appstate.edu
Dr. Christopher Thaxton, lab email: thaxtoncs@appstate.edu
- Office: R.O. Gray CAP 311/313, Telephone 262-2430
C. Thaxton CAP 351, Telephone 262-6836
- Office Hours: R.O. Gray, MWF, 2 – 3pm, TR 2:30 – 3:30pm
C. Thaxton, MWF 1 – 3pm, TR 1 – 2pm
- Textbooks: *Numerical Recipes in C, 2nd Edition*, Press, Teukolsky, Vetterling & Flannery
- Class Meetings: Lecture/Lab: Monday & Wednesday, 3:00 - 4:50pm, Rankin S306

Evaluation: Evaluation will be by means of “content” quizzes in the lecture which will be given at the end of each major section (see Class Outline below). These content quizzes will constitute 30% of the final grade. Program assignments and homework, largely carried out during lab, will be handed in and graded, and will constitute 40% of the grade. A final exam will constitute 20% of the grade. Finally, 10% of the grade will be given for perfect attendance in lecture and lab. Assignments turned in late will have 25% removed from the grade; if any assignment is overdue by one week or more will be given a grade of zero.

Attendance: Attendance in both lab and lecture is required and will count 10% of the final grade.

This class is being offered to respond to the need for Physics students to gain experience in numerical methods and in programming physics-oriented algorithms on the computer. Instruction will be given in the “C” programming language.

Class Outline

- | Lecture # | Topic |
|-----------|--|
| 1 – 5 | Introduction to the “C” programming language in the Linux environment |
| 6 – 7 | Interpolation and Extrapolation: Linear & polynomial interpolation in 1-D, Interpolation in 2 and more dimensions. |
| 8 | Roots of Functions: Bracketing and bisection; The Newton-Raphson Method |

- 9 Quiz
- 10 – 12 Minimization and Maximization of Functions: 1-D functions without and with derivatives, Multidimensional methods – the SIMPLEX and Powell methods.
- 13 – 16 Numerical Integration: Trapezoidal method, Simpson’s rule, 3-D methods and the Monte Carlo method.
- 17 Quiz
- 18 – 21 Integration of Ordinary Differential Equations: Euler’s Method, the Runge-Kutta method, Predictor-Corrector methods. Boundary-value problems: the shooting method.
- 22 – 23 Modeling of Data: Review of Least Squares, General linear least squares.
- 24 Quiz
- 25 – 28 Fourier Methods: Fourier Series, the Fourier Transform, fast Fourier Transforms, Nyquist frequency, Convolution and Deconvolution. Autocorrelation. Digital Filtering, Signal Detection, etc.