

PHSX815/PHSX615/CHEM914

Spring 2025 Preliminary Syllabus

The core part of the course will address the following topics using interesting physics problems, with an emphasis on getting you up and running as an applied computational scientist.

The order is not well defined. The plan is to first develop your overall competence in computational methods associated with items 1-5 before going into detail on a particular topic. Essential tools to start with are git (version control) and LaTeX (scientific writing).

1. Random Numbers and Monte Carlo Methods
2. Numerical Integration
3. Root-finding and Interpolation
4. Ordinary Differential Equations
 - a. Initial Value Problems (eg. equation of motion)
 - b. Boundary Value Problems (eg. TISE)
5. Data Analysis Techniques
 - a. Parameter Estimation
 - b. Hypothesis/Model Testing
 - c. Optimization
6. Simple Matrix Operations / Linear Systems
7. Eigensystems
8. Partial Differential Equations
9. Project

Additional topics may include:

10. More Advanced Statistical Methods of Data Analysis
11. Machine Learning Based Methods
12. High Performance Computing