

PHYS 220 Introduction to Computational Physics

Dates and Location:

Tuesday & Thursday 8:30PM - 9:45PM

Policy Building 206

INSTRUCTOR: Dr. Zhibo Zhang
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OFFICE HOURS: PHYS417: Friday 11:00AM~12:00PM or Through Email

Recommended TEXTS:

“A Survey of Computational Physics: *introductory computational science*” By R. H. Landau et al.

Python Multimodal eTextBook publically available from

<http://www.compadre.org/psrc/items/detail.cfm?ID=11578>

GRADING:

Homework (30%), Midterm Project (20%), Final Project (30%),
Participation/Discussion (20%)

COURSE OUTLINE:

❖ Computer Setup And Programing Warm-Up

- Computer Setup
- Python programming basics
- Numpy and Matplotlib

❖ Understanding Errors and Uncertainties In Numerical Computations

- Type of Errors
- Tricks to control errors

❖ Monte Carlo method

- 2-D random walk
- 3-D random walk
- Real-world Problem: Photon scattering in cloud

❖ Numerical Integration

- Quadrature methods

- Monte Carlo method
- Real-world Problem: Integrate Radiance to Flux

❖ **Numerical Differentiation and Root Searching**

- Bisection method
- Newton-Raphson method
- Real-world Problem: Cloud property remote sensing

❖ **Midterm Projects**

❖ **Linear algebra and matrix computing**

- Matrix inversion and Eigenvalue
- Singular value decomposition
- Real-world problem: Greenhouse effect and atmospheric temperature profile

❖ **Data fitting**

- Quadrature fitting
- Least-square fitting
- Real-world problem: Satellite data analysis

❖ **Differential Equations: ODE and PDE (if time permits)**

- Trajectory
- Wave equation
- Real-world problem: Maxwell Eq. and E&M wave propagation

❖ **Final Projects**