4350. Advanced Modern Physics I.

Instructor and office hours
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Office hours: TuTh 2PM-3PM or by appointment.

Schedule
TuTh 11:00AM - 12:20PM GAB 550A Computer Lab.

Textbook
Rubin H. Landau, Manuel J. Paez, Cristian C. Bordeianu
Computational Physics: Problem Solving with Python
Wiley-VCH

Outline
A course in modern physics specialized in the use of computers as virtual scientific laboratories. Among topics included are: Introduction to Python (the language of choice for the course); The basics of computer hardware, such as memory and CPU architecture and the basics of scientific computing: algorithms, precision, elementary numerical analysis and associated approximation and round-off errors, and parallel computing; Examples from physical systems in multiple dimensions (including topics in Quantum Mechanics, Statistical Physics, Solid State Physics and more). Each topic is studied in the context of a simple, but realistic project. A lab report format will be used for each project where the student should indicate the equations solved, the computational method, the results, and a critical discussion.

Syllabus
Any chapter listed implies that the entire chapter should be read from the book.

Python Basics/Syntax
* Logic flow, loops, functions and data structures
Algorithms & Complexity
* Big O - Program performance analysis
* Computational Tradeoffs - Speed vs
Number Representation, Errors, & Uncertainties
* Floating point overflow and underflow
  * Summing series
  * Types of Errors
Monte Carlo Methods
* Randomness and uniformity
  * Random walk
Differentiation & Integration
* Trapezoid rule, Simpson rule, & Gaussian quadrature with error analysis
  * Monte Carlo integration
Matrix Computing
* Matrices in NumPy
* Matrix operations and properties
* Two/Three masses on a string

**Trial & Error Searching**
* Bisector searching
* Central difference searching

**Solving ODEs and ODE Applications**
* Runge-Kutta Rule

**Parallel Computing**
* Parallel computing
* Performance & Amdahl’s
* Message passing and scalability

**Fourier Transforms**
* Discrete transforms
* Fast Fourier Transform

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*The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available to you on-line at the end of the semester and will provide you with an opportunity to provide feedback to your course instructor. SPOT is considered to be an important part of your participation in this class. In addition to SPOT, there will be a brief in-class course survey during the last two weeks of the semester.*

Near the end of the Fall 2017 semester you will receive an email on from "UNT SPOT Course Evaluations via IASystem Notification" ([no-reply@iasystem.org](mailto:no-reply@iasystem.org)) with the survey link. Please look for the email in your UNT email inbox. Simply click on the link and complete your survey.

After logging in to the [my.unt.edu](http://my.unt.edu) portal, students can access the SPOT survey site by clicking on the SPOT icon. A list of their currently enrolled courses will appear. Students complete each course evaluation independently. During the long terms, the SPOT is open for students to complete two weeks prior to final exams. During the Fall term, the SPOT is open for students to complete six days preceding their final exam. See [https://spot.unt.edu/content/fall-2017-8w1-calendar](https://spot.unt.edu/content/fall-2017-8w1-calendar) for specific dates and deadlines.