Applied Physics 156 AY 2018-2019, 1st semester

Course code	Applied Physics 156
Course title	Computer Methods in Physics II
Description	Advanced computer programming methods; numerical modeling and simulations; discrete models; stochastic methods; current approaches in numerical modeling
Credit	4 units

Class hours WF 10:00-11:30AM, NIP F210 (lec)
T/W/Th 1:00-4:00PM, CSRC (lab)

Objectives For the students to:
1. perform numerical modelling and simulation using Python;
2. tackle physics problems involving discrete models and stochastic methods;
3. demonstrate understanding of course concepts through regular classwork.

Prerequisite Applied Physics 155

Grading system

80%	Quizzes (10 points per activity)
20%	Written report

Grading scale (numerical scores are rounded off to the nearest integer)

90 - 100	1.0
85 - 89	1.25
… (increments of 5)	
50 - 54	
45 - 49	4.0
0 - 44	5.0

Conduct of classes. You are expected to read the assigned readings before the start of classes. Lab classes will be devoted towards coding and testing your understanding of the methods discussed in class. A summary of the pitfalls encountered by the class during the lab period and methods to avoid them will be discussed in subsequent lecture sessions.

Source codes. Work that you turn in must be your own. Unless explicitly allowed, do not use code that is downloaded online, even if properly cited. For the purposes of this course, understand and rewrite.

Main reference. W. Kinzel, G. Reents. Physics by Computer: Programming of Physical Problems Using Mathematica and C. Springer. 1997. - Main text, except for the code portions - Python code will be given.

Academic Dishonesty. You may freely discuss assignments with each other. But all work, including computer code, that you turn in must be your own. In addition to being reported to the College for possible violation of the Student Code, sharing code or results will result in zero credit.

Online resources. Detailed description of each activity are posted in the AP156 UVLe page. Get an account in notebooks.azure.com, as well as in github.com.

Manuscript. You are expected to turn in a report on one of the problems in the book.

Important dates

17 Oct	Manuscript due
31 Oct	Deadline for dropping
14 Nov	Revised manuscript due

16 Nov	Deadline for filing LOA
03 Dec	End of classes

Course coverage. Some changes may occur depending on time and the interest of the class.

Week	Topic	Objectives
1	Programming review & essentials of manuscript writing	Recall and learn new programming essentials
2	Nonlinear pendulum	Generate and plot the solution for the nonlinear pendulum. Use advanced graphing techniques.
3	Nonlinear fit	Estimate the quality of a fit by the chi-square test. Create contour plots.
4	Electrical circuits	Solve LRC circuits with arbitrary input voltages using Fourier transforms, Ohm's law, and Kirchhoff's laws.
5	Chain vibrations	Implement a simple model to calculate the lattice vibrations in a crystal. Interpret the values of the eigenvalues and eigenvectors.
6	Population dynamics	Demonstrate deterministic chaos using a logistic map. Calculate the Lyapunov exponent for the logistic map.
7	Fractal lattices	Construct a Sierpinski gasket.
8	Chaotic pendulum	Numerically calculate the solution to a nonlinear pendulum with a frictional force, which is driven by a periodic external force.
9	Discussion session	
10	Fractal aggregates	Construct various patterns using diffusion-limited aggregation.
11	Percolation	Demonstrate phase transitions using a percolation model.
12	Polymer chains	Simulate polymer chains using a self-avoiding random walks.
13	Ising ferromagnet	Construct an interactive program for an Ising ferromagnet.
14	Traveling salesman problem	Demonstrate simulated annealing
15	Networks	Describe basic metrics in graph theory.
16	Discussion session	