

SYLLABUS PHYS-GA 2000: COMPUTATIONAL PHYSICS  
NEW YORK UNIVERSITY  
DEPARTMENT OF PHYSICS  
Fall 2022

**Lectures**

Tuesday & Thursday from 12:30 PM - 1:45 PM at 726 Broadway, Room 1045

**Recitations**

Tuesday 3.30 PM - 4.45 PM at 726 Broadway, Room 802

**Instructor**

Prof. Dries Sels

Contact: [dsels@nyu.edu](mailto:dsels@nyu.edu),

Office: 726 Broadway, Room 1073

Office Hours: Wednesdays 1:30 – 2:30 PM (in person) and by appointment on Zoom

**Teaching Assistant**

Jessica Salcido

Contact: [jms1674@nyu.edu](mailto:jms1674@nyu.edu)

Office: 726 Broadway, Room 910

Office Hours: ??

**Course Website**

On NYU Brightspace

**Course Description**

This course will introduce the concepts of computational physics, the application of computers to solve physics problems. We will learn and use the Python programming language in this course. Computation is an indispensable tool in physics; very little in

computational methods. Upon completion of this course, students will have the basic computational tools needed to solve physics-related problems, both in industry as well as graduate-level research. We will cover the following broad topics:

- Python Programming
- Numerical analysis and computational complexity
- Differentiation/Integration
- Linear Algebra
- Root-finding/Optimization
- Fourier Analysis
- Ordinary & Partial Differential Equations
- Random Processes/Monte Carlo methods
- Machine learning

## **Programming Language**

We will use Python in this course. It is free, modular, and has broad adoption in both industrial and academic research settings. Although there are important differences with other languages such as C, Fortran, the concepts introduced in this course will be transferable.

## **Graduate Prerequisites**

This is a core curriculum. There are no prerequisites to this course.

## **Material**

Lecture notes, slides and code will be made available on a weekly basis

### Main text:

- M. Newman, Computational Physics (1st Edition – Revised & Expanded), 2013
- R. Landau, M. Páez, and C. Bordeianu, Computational Physics (3rd Edition), 2015

### Additional Reading:

- W. Press, S. Teukolsky, W. Vetterling, and B. Flannery, Numerical Recipes (3rd Edition), 2007
- J. Van Der Plas, Python Data Science Handbook – available for free online (google book title)

## **Problem Sets**

O(7) problem sets will be assigned up until the beginning of November. The problem sets will be posted on the course website on Tuesday of the week that the relevant material is presented and are due at 11:59 PM of the following Tuesday. The solution will consist of a Jupyter notebook containing the code, results and writeup.

The assignment can be discussed with the instructor, other students, or anyone else. However, everyone will be required to turn in their own independent code and reports.

## **Late Homework Policy**

Late homework will be accepted for reduced credit – 75% credit for up to 2 days late, 50% credit for longer.

## **Exams**

There are no exams in this course.

## **Final Project**

A major part of your grade will be a large project performed individually, culminating in a presentation between mid-November and December. A list of possible project topics will be provided, although students are encouraged to propose their own. Students will hand in a report written in LaTeX. The draft report is due mid-November, after which presentations will commence. The final report is due December 14.

**Grading** Problem Sets – 60% & Final Project – 40% (20 Code, 10 Writeup, 10 Presentation)