Lectures: Tuesdays & Thursdays 12:30 – 1:45 PM; 726 Broadway, Room 1067

Recitations: Wednesdays 5:00 – 6:15 PM; 726 Broadway, Room 1025

Instructor: Prof. Anthony R. Pullen
Contact: anthony.pullen@nyu.edu, 212-998-7634
Office: 726 Broadway, Room 938
Office Hours: Wednesdays 1:00 – 2:00 PM and by appointment

TA: Watee Srinin
Contact: ws907@nyu.edu, (212) 998-7720
Office: 726 Broadway, Room 610
Office Hours: Mondays 5:00 – 6:00 PM

Course Website:
Located on NYU Classes

Course Description
This course will introduce the concepts of computational physics, the application of computers to solve physics problems, at the undergraduate level. Computation is an indispensable tool in physics; it covers all branches of physics and has applications in both theoretical and experimental physics. Upon completion of this course, the student 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 topics:
• Numerics
• Differentiation/Integration
• Linear Algebra
• Root-finding/Optimization
• Differential Equations
• Fourier Analysis.

Programming Language
We will use Python in this course. It is free, modular, and has broad adoption in both industrial and academic research settings. The concepts introduced in this course will have equivalent applications with most computational languages including C, Fortran, Java, IDL, and Julia.

Prerequisites
• Classical & Quantum Waves (PHYS-UA-105)
• Mathematical Physics (PHYS-UA-106)

OR
• Foundations of Science 6 (SCIEN-AD 113 & 117)
• Calculus I (MATH-UA 121)

See Prof. Pullen if you have not satisfied either of these sets of prerequisites.

Required Textbook

Other References
• J. Van Der Plas, *Python Data Science Handbook* – available for free online (google book title)

Classes/Recitations
The class will be participatory; participation counts for 10% of your grade. Make sure to read the relevant chapters before attending class. Please bring your laptop to class if you have one; you will be expected at certain points in the lectures to follow along with calculations on your laptop. Lecture notes will be available before each class period.

Recitations will take place Wednesday evenings and will include a brief review of the material, opportunities to ask questions, and help with homework assignments.

Problem Sets
Eight problem sets will be assigned up until the beginning of November. The problem sets will be posted on the course website on Friday at the end of the week that the relevant material is presented and are due at 11:59 PM the following Friday. The solution will consist of a report written in LaTeX and a Jupyter notebook containing the code and results. The solutions must be submitted to the GitHub classroom repository for this course. I will explain this more on the first day of class. DO NOT submit a printed solution set to the TA or me; they will not be accepted. Solution sets will be posted on the course website on the Monday after its due. Grades will be returned within a week after the homework due date.

Students can discuss the assignment with the instructor, other students, or anyone else. However, students are always required to turn in their own independent code and reports.

Late Homework Policy: Late homeworks will be accepted for reduced credit – 75% credit for up to 2 days late, 50% credit for longer.

Final Project
A major part of your grade will be a large project performed in groups of two students each, culminating in a presentation between mid-November and December. Project
topics will be provided. You will also hand in a report written in LaTex. The draft report is due November 16, after which presentations will commence. The final report is due December 14.

**Exams**
There are no exams in this course.

**Grading**
- Problem Sets – 65%
- Final Project – 25%
- Class Participation – 10%

**Tentative Schedule**
The following schedule is tentative and subject to change.

<table>
<thead>
<tr>
<th>Class Dates</th>
<th>Topics</th>
<th>Landau Chapters</th>
<th>Problem Set Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/4, 9/6</td>
<td>Number Representations &amp; Arrays</td>
<td>1, 2</td>
<td>9/14</td>
</tr>
<tr>
<td>9/11, 9/13</td>
<td>Numerics</td>
<td>3</td>
<td>9/21</td>
</tr>
<tr>
<td>9/18, 9/20</td>
<td>Random Numbers</td>
<td>4</td>
<td>9/28</td>
</tr>
<tr>
<td>9/25, 9/27</td>
<td>Differentiation &amp; Interpolation</td>
<td>5</td>
<td>10/5 (Teams Declared)</td>
</tr>
<tr>
<td>10/2, 10/4</td>
<td>Integration</td>
<td>5</td>
<td>No Homework due on 10/12</td>
</tr>
<tr>
<td>No class Tues 10/9 (Legislative Day) 10/11</td>
<td>Integration</td>
<td>5</td>
<td>10/19</td>
</tr>
<tr>
<td>10/16, 10/18</td>
<td>Linear Algebra</td>
<td>6</td>
<td>10/26</td>
</tr>
<tr>
<td>10/23, 10/25</td>
<td>Eigensystems</td>
<td></td>
<td>11/2</td>
</tr>
<tr>
<td>10/30, 11/1</td>
<td>Root-finding &amp; Optimization</td>
<td>7</td>
<td>11/9 (Last Homework)</td>
</tr>
<tr>
<td>11/6, 11/8</td>
<td>Ordinary DEs</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>11/13, 11/15</td>
<td>Fourier Analysis</td>
<td>12</td>
<td>Draft Report Due (11/16)</td>
</tr>
<tr>
<td>11/20</td>
<td>Partial DEs</td>
<td>19</td>
<td>Presentations begin</td>
</tr>
<tr>
<td>No class 11/22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/27, 11/29</td>
<td>Partial DEs</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>12/4, 12/6</td>
<td>Diffusion &amp; Nonlinear Dynamics</td>
<td>20, 15</td>
<td></td>
</tr>
<tr>
<td>12/11, 12/13</td>
<td>Data Compression &amp; High-Performance Computing</td>
<td>13, 10</td>
<td>Final Report Due (12/14)</td>
</tr>
</tbody>
</table>