2023

PHYS 275: Intro to Scientific Computing

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Scientific Computing

Suitable modalities: In-Person, Online (SYNC/ASYNC), HyFlex
Creedit: 4

Course Description:

General Description

A course in numerical methods of analysis and modeling of physical phenomena with a focus on problems arising in various areas of physics. The topics include classical dynamics and electromagnetism using finite difference and finite element methods, stochastic/Monte-Carlo methods, and matrix eigenvalue problems. Students are not required to have previous programming knowledge and will be introduced to scientific and engineering computing based on MATLAB. Students can use CUNY's MATLAB license to access the software: https://www.mathworks.com/academia/tah-portal/city-university-of-new-york-1111017.html

A similar open-source software can be access here: https://octave.org/

Prerequisite

Physics 1464 & 233

Textbook:

This class follows a Zero-Cost model that will use various Open Educational Resources. Some of the textbook resources are listed below and posted on the course Blackboard site:

- Numerical Methods with Applications - A. Kaw
  http://nm.mathforcollege.com/NumericalMethodsTextbookUnabridged/
- Tea Time Numerical Analysis - L. Q. Brin
  https://lqbrin.github.io/tea-time-numerical/index.html
- Numerical Methods for Ordinary Differential Equations - C.Vuik, F.J. Vermolen, M.B. van Gijzen & M.J. Vuik
  https://doi.org/10.5074/t.2023.001
- Zero to MATLAB - A. L. Lambert
  https://open.oregonstate.education/matlab/
- MATLAB: An Introductory Course - R. Matusky
  https://www.oercommons.org/authoring/4896-matlab-an-introductory-course
- Physical Modeling in MATLAB - A. B. Bowney
  https://greenteapress.com/wp/physical-modeling-in-matlab/

Topic List

Week #	Topic
1	Intro to MATLAB and Scientific Computing
2	Basic Programming (Scripting) with control Structures
3	Creating Functions and Solving Equations
4	Root Finding Methods
5	Integration and Numerical Quadrature
6	Numerical Differentiation and Adaptive Quadrature Methods
7	Vector Fields and Flux
8	Introduction to Monte Carlo Methods
9	Random Walks and Brownian Motion
10	ODEs: Methods and Best Practices
11	ODEs: Modeling Projectile Motion under Nontrivial Forces
12	Coupled ODEs: Coupled Oscillators
13	PDEs in 1D: Heat and Wave Equations
14	PDEs in 2D: Heat and Laplace Equations

What to Expect When Taking This Course:

General Information

There are no in-class exams in this course. Your grade is purely based on your performance on weekly homework assignments and two group projects.

Assignments

Homework assignments will be posted on Blackboard and must be submitted via Blackboard. The assignments are expected to take a few hours to complete and generally due a week after the material is covered. Late submissions will be penalized by 10% reduction for each day after the deadline.

Projects

Instead of in-class exams midterm and final exams, there will be a two projects (midterm and final) where you will work in a small group (2-3 students) to complete. The assignments are intended to be a summative assessment where each group will submit and present their work are a whole. The workload should be split evenly among group members and the division of tasks must be included in the project submission. Late submissions will not be accepted.

Grading Rubric:

Course grades will be calculated using the following weights for each category:

Category	**Weight (%)**
Homework	50
Projects	50
Extra Credit	0

The letter grade for the course will be assigned, according to College Policy, as follows:

Grade	**Score**	**Grade**	**Score**	**Grade**	**Score**
A+	> 97	A	93 – 97	A-	90 – 92
B+	87 – 89	B	83 – 86	B-	80 – 82
C+	77 – 79	C	73 – 76	C-	70 – 72
D+	67 – 69	D	60 – 66	F	< 60

Reasonable Accommodations for Students with Disabilities

Students with disabilities needing academic accommodations must do the following

- Register with the Office for Special Services
- Submit a letter indicating the need and type of accommodation within the first week of class.

For further information, visit Special Services for Students with Disabilities website: https://www.qc.cuny.edu/sp/

Academic Dishonesty

The CUNY Academic Integrity Policy will be strictly adhered to. The policy can be found at: https://www.cuny.edu/about/administration/offices/legal-affairs/policies-resources/academic-integrity-policy/
Violations will be reported to the Office of Student Affairs, and will be subject to severe grading penalties.