University of Maryland - Department of Physics

Spring 2024 Carter Hall and Peter Teuben Physics 265

Title: *PHYS 265: Introduction to Scientific Programming.* **Testudo description:** *Introduction to scientific programming with python. Basic data types, sequences, input/output, and program control flow structures. Evaluation and plotting of mathematical functions and data. Statistical interpretation of data, and fitting of data to models. Introduction to numerical methods including integration, solutions of ordinary differential equations, and linear algebra. Extensive use of the numpy, matplotlib, and scipy packages.* **Prerequisites:** PHYS171, PHYS141, or PHYS161; or must have scored 3 or higher on AP PHYS exam.

Instructors:

- Dr. Carter Hall, e-mail: crhall@umd.edu; Office is PSC 2114.
- Dr. Peter Teuben, email**:** teuben@umd.edu, Office is ATL 0223.

Contacting us: Send an email to crhall@umd.edu or teuben@umd.edu with a subject line beginning with "PHYS265". You can also message us on ELMS, but email is much more likely to get our attention.

TA/grader: Sophia Jean, sjean022@terpmail.umd.edu.

Office Hours: Will be held both in-person in our offices and on zoom.

- Carter: Thursday 1 - 3 pm in PSC 2114, and on umd.zoom.us/my/carterhall
- Peter: Thursday 3 - 5 pm in ATL 0223, and on umd.zoom.us/my/teuben
- You can also schedule an appointment with us via email (subject line: "PHYS265"), or schedule with us before or after class.

Schedule: MWF 12:00 pm to 12:50 pm in Edward St. John (ESJ) 2309.

Required Text: *Learning Scientific Programming with Python*, Christian Hill, 2nd edition, ISBN 13: 9781108745918. Cambridge University Press

Homework: Homework is due each week at 11:59 pm on Thursday night. There will be nine homework assignments. Each of the nine assignments are worth an equal amount. Note that no late homework or make-up homework will be accepted, except by prior arrangement with a valid excuse, or in other exceptional cases (such as a medical emergency) in accordance with university policy. **Labs**: You will complete two computer labs, each occupying one week of class time. Your submitted lab work will include your python code and a two-page report. Labs are due at 11:59 pm on Thursday March 28 (Lab 1) and 11:59 pm on Sunday April 28th (Lab 2).

Technology: We will be using the Anaconda distribution of python, available for MacOS, Windows, and Linux. **ELMS**: Course information will be posted on ELMS/Canvas. **Github:** Students will submit some assignments via a github repository. More information about github will be provided.

Class Participation: Each day in class you will do exercises on your machine, please bring your laptop to class. A full battery charge will be useful, but power receptacles are available in the classroom. You will submit your classwork for class participation credit. Each class will be worth 1 point; the denominator for calculating the final credit will be 35. 100% is the maximum credit available.

Exams: We will have three in-class mid-term exams. The final exam will be held on Thursday May 16 from 8:00 – 10:00 am.

Exam 3 Code Project: For the third mid-term exam, students can propose a code project to substitute for the exam. Project proposals need to be approved by the instructors. See Peter and Carter for more information.

Credit and grading scale: Homework: 20%. Labs: 20% total. Class participation: 20%. Mid-term exams: 20% total. Final exam: 20%. A ten-point grading scale will be used to assign final letter grades, with the "-" and "+" grades reserved for the lowest three and highest three points in each bracket. For example, 87% to 89% will be a B+, 83% to 87% will be a B, and 80% to 83% will be a B-.

Daily handouts: Each day we will provide a hardcopy handout describing the course material to be covered in class that day. The daily handouts will be posted in pdf form on ELMS once per week; they will not be posted each day. The handouts will be three-hole punched. You are encouraged to purchase a three-ring binder to collect the handouts in one place.

Academic Integrity. All university policies regarding student rights and obligations, including academic integrity (cheating), are available at: http://www.ugst.umd.edu/courserelatedpolicies.html. You are welcome to work together on homework, labs, and on in-class exercises. **However, you are not allowed under any circumstances to share anything electronically, including code, plots, or anything else**. For submitted work, **you are also not allowed to copy code from the internet, nor are you allowed to use AI algorithms such as ChatGPT.** You may copy code from (1) the textbook; (2) in-class exercises; (3) notes that we provide to you; (4) your own classnotes.

Physics 265 - Spring 2024				
Date	Week	Class Topics	Hill Textbook	Due
1/22	1	No class		
1/24		Introduction		
1/26		numbers, variables, data types	2.2	HW1
1/29	2	comparison, logic, strings	2.2, 2.3	
1/31		str format, lists and loops, control flow	2.3.7, 2.4, 2.5	
2/2		user defined functions	2.7	HW2
2/5	3	basic 1D plotting with pyplot	3.1, 3.2	
2/7		numpy array methods	6.1	
2/9		OO plotting and subplots	7.1, 7.2	HW3
2/12	4	Text, latex, and 2D functions	7.4.1, 7.5, 7.6	
2/14		2D functions	7.5, 7.6	
2/16		vector field plots		HW4
2/19	5	reading and writing arrays	6.2.2, 6.2.4	
2/21		plotting data with errorbars & histograms	7.2.6, 3.3.2	
2/23		exam review		HW5
2/26	6	mid-term exam 1 (python, numpy, pyplot)		
2/28		numerical integration with quad()	8.2.1	
3/1		Euler method		
3/4	7	Ordinary Differential Eqs. with solve_ivp()	8.2.3	
3/6		Ordinary Differential Eqs. with solve_ivp()	8.2.3	
3/8		Ordinary Differential Eqs. with solve_ivp()	8.2.3	HW6
3/11	8	Ordinary Differential Eqs. with solve_ivp()	8.2.3	
3/13		Lab 1 - ODEs		
3/15		Lab 1 - ODEs		HW7
		spring break		
3/25	9	Lab 1 - ODEs		
3/27		Lab 1 - ODEs		
3/29		exam review		Lab 1
4/1	10	mid-term exam 2 (integration and ODEs)		
4/3		propagation of uncertainties		
4/5		random numbers	6.6	
4/8	11	Solar Eclipse! Standard deviation of the mean		
4/10		chi-squared; p-value		
4/12		chi-squared; p-value		HW8
4/15	12	one parameter chi-squared fits	8.4.2	
4/17		Fitting data with curve_fit()	8.4.2	
4/19		Fitting data with curve_fit()	8.4.2	
4/22	13	Lab 2 - Data Analysis		HW9
4/24		Lab 2 - Data Analysis		
4/26		Lab 2 - Data Analysis		
4/29	14	exam review		Lab 2
5/1		mid-term exam 3 or code project (data analysis & fitting)		
5/3		linear algebra / root finding / minimization	6.5, 8.4.3	
5/6	15	linear algebra / root finding / minimization	6.5, 8.4.3	
5/8		Exam review - Last day of class		HW10 (optional)
5/16	16	Final Exam Thursday May 16 8 am in ESJ 2309		