Physics 351 Fall 2019 Computational Methods for Physicists and Engineers

Instructor:	Dr. Brianna Thomas	Class Time:	T/Th 3:05pm-4:20pm
	SCI 123-A, x2977	Class Location:	SCI 122
	bthomas1@coastal.edu	Web page:	Moodle (http://moodle.coastal.edu)
	Office Hours: TBD		

Course Materials
MATLAB student license – see Moodle page for purchase information.

Description and Objectives
This course introduces students to the computational tools that physicists routinely use to analyze and to codify the foundational principles of physics. By the end of the semester a student completing this course is able to perform order-of-magnitude calculations; design and write computer programs that simulate physical systems described by multiple variables; and analyze a set of noisy data. The communication and synthesis of scientific knowledge is highlighted throughout the course via formal written reports that describe the theoretical analysis of a physical system.

Student Learning Outcomes
Student learning outcomes are measurable statements that specify what students should know and be able to do at the completion of a course. Due to their length, a complete list of the learning outcomes for this course are listed at the end of this syllabus.

Course Components
In this course, my responsibility is to assist you in learning techniques for solving typical problems that arise in physics. Conversely, your responsibility is to be actively engaged in learning the material.

Class time – The scheduled lecture time is devoted to discussions on how to approach, execute, and evaluate solutions to physical problems using the computers a processing tool. Because computational science is an intrinsically hands-on activity, class time will alternate between periods of traditional instruction, group discussion, and small-group example practice. ***You should bring a laptop to class if you are able.*** I will provide MATLAB templates for each lecture before class so you do not have to type up everything I have prepared, but you should plan on taking notes on the material so you have enough information to execute the practice problems.

Homework – Homework is another opportunity to actively engage in your learning process. It gives you a chance to independently tackle the ideas discussed in class and practicing organizing your thinking. If you get stuck, you are encouraged to attend office hours and work on the homework collaboratively ***as long as the work you turn in is your own*** (see Academic Honesty policy). Homework will be assigned on an approximately weekly basis, and will be submitted electronically.

- ***Submission format*** – Homework files *must* be submitted in the specified file format and with the specified file name. Homework assignments submitted prior to the deadline with an incorrect format or name will be required to re-submit before the assignment is graded.
- ***Late policy*** – Late homework will be accepted within a 2-hr period after the due time and will receive a deduction of 5% per half-hour late. Homework after the 2-hr grace period will not be accepted and will receive a 0.

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- ***Extensions*** – Homework extensions past the 2-hr grace period will only be granted under extenuating circumstances at my discretion, and ***must*** be arranged in advance.
- ***Grading*** – Two of the five homework problems will be randomly selected for detailed grading out of 5 points each; the remaining problems will be graded out of 1 point. The 1-point problems will be graded primarily out of completion. The 5-point problems will be graded by the following rubric:
    - 0 points for no effort (duh!)
    - 1 point for an attempt but if no reasonable progress is made
    - 2 points if some attempt is shown, which includes some relevant preliminary calculations or a clear demonstration of the right technique that is needed to solve the problem
    - 3 points if a reasonable attempt is given but a crucial mistake is made
    - 4 points for a nearly perfect solution but there's a minor error
    - 5 points for a perfect solution
- ***Regrade policy*** – Detailed solutions will be posted after the homework due date. Requests for a regrade of a homework problem must be ***submitted in writing within a week of your receiving the graded assignment***. You must submit a sheet of paper or email describing your request. You are welcome to explain your reasoning in person as well, but I do not make on-the-fly grade corrections. I am under no obligation to grant a regrade.

Assessment Quizzes – To assess that students are reaching the learning outcomes, a short quiz will be administered at the end of each of the three major topics covered in the course (see Rough Schedule at end of syllabus). The questions are based on lecture material and homework assignments. These quizzes will be completed in class using paper and pencil, no computers.

Projects – A substantial amount of time outside the class is spent on student projects. These projects are designed for students to synthesize multiple subfields of physics and approaches to solving problems; thus, they play the role of exams in other courses. In designing the projects, students have to be creative and work independently from strictly guided instruction. At the completion of each project students are required to submit a written report.

- ***Schedule*** – Guidelines for each project will be posted partway through the applicable unit. Students will select a topic either from a pre-approved list or of their own design and submit it for approval by a specified deadline. No two students may work on the same project topic. Prior to submission of the project, students will be given the rubric used to assess the project. Projects must be submitted electronically on Moodle by the deadline.
- ***Grading*** – Projects have two phases: a rough draft phase which is submitted anonymously and peer reviewed (20pt), and a final submission graded by me (80pt).
    - The rough draft will be due roughly a week before the final due date and will be submitted with all identifying details removed from the document.
    - Immediately after the (anonymized) draft submission, each student will have a few days to assess three of their peers' reports using the same rubric as the final submission. This serves as an opportunity for students to assess each other's work and provide feedback for improvement. Your grade for this portion will be assessed based on the quality of your feedback to others.
    - The final project will be due 3-4 days after peer grading is complete. The final submission will be graded by me using the rubric given with the project.
    - Your project grade is a sum of the peer review grade (max 20pt) and final grade (max 80pt).

- ***Grade appeals*** – Students may appeal their project grade via a written document given to the instructor either in-person or electronically, ***no later than 1 week after the grade is received.*** After a written appeal request is received, the instructor will re-assess the report in light of the appeal. The instructor is not obligated to fulfill requests in the appeal if they deem them not warranted.
- ***Late policy*** – Due to the long-term nature of the projects and the review process, no late submissions will be accepted. *Neglecting to submit a draft* will remove you from the peer review pool and will result in a 0 for the peer review portion. *Late final submissions* are not accepted and will receive a 0 for the final submission grade portion.
- ***Extensions*** – Extensions on projects will NOT be granted except in exceptionally extenuating circumstances.

MATLAB – MATLAB is the primary computational tool in this class. Some familiarity with MATLAB prior to class is helpful but not necessary. Class time is used for demonstrating some syntax and specific techniques, but it's also expected that students explore MATLAB on their own and to use suggested resources as aids in learning the possibilities the software package offers.

Grading:

Fermi Analysis Project	10%
Simulation Analysis Project	15%
Stochastic Analysis Project	20%
Homework	25%
Assessment Quizzes Total	30%

Grading Scale:

Excellent:	A	100.0 – 90.0
Good:	B+	89.9 – 87.0
	B	86.9 – 80.0
Average:	C+	79.9 – 77.0
	C	76.9 – 70.0
Poor:	D+	69.9 – 67.0
	D	66.9 – 60.0
Failing:	F	59.9 and below

Class attendance is vital to your understanding of the material, and attendance expected. Students are responsible for all course materials, assignments, and instructions given during class meeting times; neither absences nor inattention waives these responsibilities. It is imperative that students attend class and arrive on time. Arriving late to class is a disruption and is not tolerated. Out of respect for other students and the instructor, if a student feels that they will be or are a distraction (due to illness or other reasons), then they are encouraged not to attend class. If there is a distraction during class the professor will ask the offender to leave.

Adverse Weather Contingency

In the event that classes are canceled due to adverse weather, class will immediately revert to asynchronous online instruction. Full textbook-style lecture notes will be uploaded to Moodle instead of the templates, and students are expected to download these notes, read them thoroughly, and work through the examples on their own time. Additionally, I will post times for "virtual office hours/class time" during which time you can join an audio/video chat for Q&A on the class topics. Homework and Project due dates will be adjusted as needed to be due after classes resume. A portion of the first day back will be used for catch-up Q&A.

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Office Hours

Dedicated office hours – are posted on Moodle and on my schedule outside my office. During these hours I am 100% available to answer any questions you have been unable get help with otherwise.

Open door – Outside of dedicated hours, you are welcome to stop by for any reason.

By appointment – Please feel free to set up a *specific time* in person, via email, or by a call to my office, if you are unable to come to dedicated hours.

Note: Some hours on my posted schedule are explicitly allocated for prep and research. Unless you have an unavoidable conflict, please be respectful of that time being reserved.

Course and University Policies

Technology use – ***Cell phones*** are not needed or permitted during class. If there is an emergency situation, it is the student's responsibility to let me know ahead of time to make proper arrangements. ***Computers*** of course vital for this course, but should be used only for class activities. Be respectful of your classmates!

Class disruptions – If classroom distractions are a consistent problem, I reserve the right to make up lost time with an increase in homework assignments. If a single person is the source of disruptions, they will be asked to leave.

Accommodations – Coastal Carolina University is committed to equitable access and inclusion of individuals with disabilities in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act. Individuals seeking reasonable accommodations should contact Accessibility & Disability Services (843-349-2503 or https://www.coastal.edu/disabilityservices/). ***If you need accommodations in class, please notify me within one week of the start of class*** so I can plan accordingly.

Academic Honesty – Coastal Carolina University's Statement of Community Expectations
Coastal Carolina University is an academic community that expects the highest standards of honesty, integrity and personal responsibility. Members of this community are accountable for their actions and reporting the inappropriate action of others and are committed to creating an atmosphere of mutual respect and trust.

Cheating and Plagiarism are defined for Coastal Carolina University in the Student Code of Conduct, as are the procedures for dealing with such violations of community trust. For this course, a first cheating or plagiarism violation will result in a 'zero' grade for that problem, as second will result in a 'zero' grade for the whole assignment, and a third violation will result in an automatic failing grade.

In this course, some activities are meant to be collaborative (peer instruction, group work), some are meant to be largely done individually with outside help allowed either via peers or the professor (homework assignments), and some are meant to be completed as an individual (quizzes and projects).

The following constitute a violation of academic honesty: copying work from a classmate, a previous student of the class, a solution manual, or the internet; "co-writing" a non-collaborative assignment; letting others copy your work; failing to reference non-textbook sources; citing complete sentences with only one reference note; or using other forbidden resources. "I didn't know it was cheating!" is not an excuse – when in doubt, ask. Note: coding is much like any other language – while there is a shared vocabulary and syntax, each person has a unique "voice". It *is* possible to detect cheating even if certain code components are needed regardless of the author.

Revisions

This syllabus describes the course as best it can. The instructor reserves the right to make changes in its content. If changes must be made to it during the semester, students will be immediately notified.

Rough Schedule

The following schedule is a *very rough outline* only, and is subject to change. Quiz and project dates are ***tentative*** and will be finalized as the semester progresses. See Moodle for a daily schedule.

Weeks	**Dates**	**Class Topic**	**Assignments**
Wk 1-5	Aug 22 – Sept 19	Estimation Analysis	Hw 1-3
	Sept 24	***E.A. Assessment Quiz***	
	Sept 26		***Fermi Project Final***
Wk 6-10	Sept 26 – Oct 24	Computational Analysis	Hw 4-7
	Oct 29	***C.A. Assessment Quiz***	
	Nov 7		***Simulation Project Final***
Wk 11-13, 15-16	Oct 31 – Dec 3	Stochastic Analysis	Hw 8-10
	Dec 5	***S.A. Assessment Quiz***	
Finals week	***Dec 10 – Dec 16***		***Stochastic Analysis Project***

Student Learning Outcomes for PHYS 351

This course covers a lot of definitions, concepts, and techniques. Compiled together it would appear that the class covers a tremendous number of topics. Furthermore, as each lecture focuses on one particular topic and/or technique it's possible to lose sight of the bigger picture and the context with which the material is being presented. Listed below are the student learning outcomes for this course. Student learning outcomes are measurable statements that specify what students should know and be able to do at the completion of the course.

1. Students should develop a foundational understanding of the computational techniques that are essential in the practice of physics. Students should be able to:
    a. produce order-of-magnitude estimates for both simple and complex scientific questions
    b. use expansion methods as a means for estimating solutions to a complex systems
    c. dissect complex problems into smaller, related computational modules
    d. synthesize multiple computational approaches to arrive at realistic (non-idealized) solutions to complex physical problems
    e. define a probability distribution and be able to draw random deviants from a given distribution
    f. formulate and test a hypothesis using recorded data
2. Students should reinforce their expert-like problem solving skills. Students should be able to
    a. use an expert-like strategy to solve problems, both familiar and unfamiliar.
    b. evaluate other people's written solutions and solution plans
    c. test a hypothesis and conclude if the test supports or rejects the hypothesis
3. Students should reinforce an understanding of the scientific method. Students should be able to:
    a. identify scientific evidence, and explain what is and what is not scientific evidence
    b. correctly interpret scientific evidence
    c. evaluate scientific evidence, testing them against relevant criteria and standards
    d. communicate effectively with others in figuring out solutions to complex problems
4. Students should reinforce technology skills. Students should be able to
    a. use mathematical software to develop original computer simulations and demonstrations that apply foundational physics principles
    b. use technology skills related to networking computers, use of web pages and search engines, and the use of technical software applications
5. Students should improve their communication, interpersonal, and questioning skills. Students should be able to:
    a. explain physical systems in written form
    b. present a well-reasoned argument supported by observations and physical evidence
    c. evaluate written arguments, both their own and those espoused by others.