

PHYSICS 231: Methods of Theoretical Physics

INSTRUCTOR: Flip Tanedo (Phys. 3054)

MEET: MWF 10:00 – 10:50am (Chung 141)

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TA: Jon Spalding (jspal002@ucr.edu)

The TA discussion section is scheduled for Monday 3-3:50pm in MSE 113. This portion will be used as a TA office hour.

Critical Information

WEBPAGE: <https://sites.google.com/ucr.edu/p231/home>

Lecture notes, homework and our course calendar are posted there. Internal material may be posted to iLearn.

We will use the designated lecture *and* discussion slots as meeting times.

Course Description

This is a crash course in (a) mathematical methods for physics and (b) necessary science communication for your Ph.D. The topics are selected to be useful in your graduate coursework and research. This is not a mathematics course, it is *boot camp* for physicists.

Evaluation

- Five homework assignments (two parts each) will be assigned every other Monday.
 - **Short homework** [5 pts] due the following Wednesday.
Quick reminders of key points in lecture, feedback on topics that may not be familiar.
 - **Long homework** [20 pts+] due in 2 weeks.
More detailed calculations, some short writing component. Optional ‘extra credit’ problems.
- Over the course of the quarter, each student will give **one 5-10 minute presentation** [75 pts] on the solution to a pre-selected problem on the homework assignments.
- Periodic in-class assessment in the form of **index cards** [5 points each] will be used to help me tailor the course trajectory.
- No exams. I expect you to *work together* and to abide by the [UCR academic integrity policies](#).

Course Objectives

The contents of this course build a mathematical foundation that is at the core of graduate-level physics and astronomy. The topics are chosen to provide a foundational understanding of the mathematical methods needed in the first year graduate curriculum.

The course methodology is designed to build soft skills necessary to succeed in academia. Being able to effectively communicate one’s technical work (or technical confusion) to an audience of peers is a key skill in the rest of your scientific careers, academic or otherwise.

Textbook

The *suggested* textbook is *Mathematics for Physics & Physicists* by Appel (ISBN: 9780691131023). You are free to use whatever mathematical physics references you are most comfortable with. Some suggestions are on the course webpage.

Topics

The main theme of the course will be understanding how to solve the partial differential equations that pop up in physics using Green's functions. The rough number of weeks is an estimate.

1. **Dimensional analysis.** [1 week] How do you tell a physicist from a mathematician?
2. **Differential equations.** [2 weeks] Are differential equations just linear algebra?
3. **Complex Analysis.** [1 week] How do I integrate around poles?
4. **Green's functions.** [4 weeks] How do I solve differential equations?
5. **Variational principles.** [1 weeks] Where did these equations come from?
6. **Special Topics.** [2 weeks] Special topics to be decided. Possibilities include: probability and statistics (how do you know when you've discovered something?), statistical learning (what is machine learning?), differential geometry (what is a magnetic monopole?).

Inclusive Accommodation, Support

Students who need any accommodations that require my attention should contact me in the first week of class. Students with permanent or temporary disabilities should be sure to make accommodations with the Student Disability Resource Center.

We are committed to an inclusive classroom where our views may be challenged, but where we will always respect each other's dignity and humanity. We each have a responsibility to hold ourselves and one another (including faculty) accountable for maintaining this standard. In the case of any incidents in the classroom, we will (1) find a respectful resolution together, or if this is not possible (2) discuss with the necessary parties outside of the class, or if neither is feasible, (3) reach out to either [Help at UCR](#) and/or the [Office of the Ombuds](#).