Physics 466: METHODS OF THEORETICAL PHYSICS

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Class Meets: Monday 11-12:30, Friday 11-12:30, Problem session Monday 12:30-1:30, All in classroom 5


Class Calendar: Linked off the web page, this google calendar will have key info such as exam dates, homework due dates, lecture dates, review sessions, &c.

The purpose of this course is to introduce students to mathematical concepts and methods used by physicists in scientific research. Becoming facile at the application of the methods introduced in the course can only be accomplished through solving problems; a passive understanding of the underlying concepts will not be sufficient when the need for these methods arises in future work. For this reason, completing the homework and participating in the problem sessions will be required. The use of computational tools such as Mathematica or Python will be allowed under some circumstances because these elements play an important role in most modern physics research. However, many of the underlying concepts are difficult to comprehend without spending at least some time manually computing the solutions to problems using analytic methods, therefore I urge you to use computational tools mainly as a way of checking your work. This course is required for all graduate degrees in physics and astronomy, and is strongly recommended for undergraduates with plans to pursue careers in physics or astronomy.

I have selected the textbook Arfken, Weber and Harris partly because it is an incredibly complete reference that I anticipate you will consult often if you go on in physics. It is generally clear and fairly concise, but obviously it contains far more material than we could possibly cover in a semester. I propose the following topics, divided into three sections:

1) Vector analysis and coordinate systems, determinants and matrices, vector spaces, eigenvalue problems, an introduction to differential forms
2) Infinite series, complex variables and complex analysis
3) Differential equations, Green's functions, Fourier transforms and special functions

We may or may not have time to cover all of these topics, and we may choose to explore further topics if time allows. As much as possible, I will adjust the pace of the class to accommodate the students' level of preparation.

There will be two midterm exams, and a final exam. Each of these may potentially include a take-home component. The in class portion will be non-collaborative and the use of computational tools will not be allowed. If there is a take-home portion, it will be collaborative and open resource. There will also be short quizzes, given at the start of some classes. You will get credit if you take the quiz and there are no make up quizzes. Quizzes are a tool I use to assess which concepts are giving you difficulties. The breakdown of the final grade will be as follows: Midterm 1 – 25%, Midterm 2 – 25%, Final (comprehensive but with an emphasis on the third section of the class) – 25%, Homework – 20%, Quizzes – 5%. The exact dates of the midterms and the finals will be determined during the course.

Homework assignments and suggested reading will be posted in the notes on our class google calendar, which you can find on our web page. This calendar will be updated as the pace of the course is adjusted, so please check back each week as the assignments may shift slightly.