

PHYSICS 8640  
Spring 2015

Lecture: 2:00 - 3:15 a.m. TuTh, Physics Building, Room 210

Instructor: Peter Arnold, Physics Building, Room 320

Office hours: drop by any time, or by appointment if that doesn't work.

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TEXT: Peskin and Schroeder, *An Introduction to Quantum Field Theory*.

There is no single quantum field theory book that is good for every topics, even within a given subfield. So, for any given topic you want to know about, flip through the indexes of a lot of quantum field theory books (such as those on the reserve shelf for this course in the library) until you find one with a discussion of that topic that you like.

### Grade weighting

80% Homework

20% Final presentation [default time: Monday morning, May 4, 9:00-12:00]

**except** that I reserve the right to decide that I want to give some short in-class quizzes during the semester. If I do, such quizzes would in total count for no more than 5% of the grade (carved out of the 80% for homework)

**Final Presentation:** Instead of a traditional final exam, you will instead prepare a presentation to give to me and the class on some topic in field theory during the final exam time slot. The topic will be suggested by you but must be approved by me. Details will follow later. We will also discuss later when to schedule the presentations, and how long each will be, but for now reserve Monday morning, May 4, 9:00-12:00 (our final exam time slot) as a default.

**Homework:** Will always be due at the **start** of the class in which it is due. Late homework will be assessed a penalty, which will grow as time increases. (If you know you have some scheduling problem in advance, just talk to me about it in advance.) Collaborating on working out methods of solution is actively encouraged! Copying another person's solution that you did not substantially participate in is unacceptable. In particular, do not look at anyone's solutions from previous years, and do not look up solutions to assigned Peskin problems on the internet (at least, not until after you've turned them in). I would consider doing so a violation of the honor code.

**Topics covered (subject to change):** Loop diagrams, regularization, renormalization, running of coupling constants (and consequences such as triviality, asymptotic freedom, and Standard Model vacuum instability), introduction to finite-temperature quantum field theory, application to the  $\epsilon$ -expansion method for critical exponents in condensed matter systems, the hierarchy problem, Ward identities, non-abelian gauge theory (the basis for the theories of QCD and the weak interactions), spontaneous symmetry breaking, the Higgs mechanism.