

# Quantum Field Theory A (Physics 215A)

## Fall 2023

**Lecturer:** John McGreevy

Office Hours: After lecture or by appointment.

### Use of the Web:

The course web page is

<http://mcgreevy.physics.ucsd.edu/f23/> .

Problem sets, solutions, lecture notes, handouts, announcements, *etc* will be distributed via this page. You should check it regularly (*e.g.* before each lecture) for new material. It will help to look at the relevant lecture notes before the lecture happens.

Problem set hand-in and return will happen through Canvas.

**Content:** This course will be an introduction to perturbative quantum field theory, mostly relativistic. We'll see how much of the content of Part I of Peskin's book we can get our heads around in a quarter. I will try to emphasize connections with many-body physics. The table of contents of the lecture notes is a good outline of the plan.

### Texts:

I do not plan to follow any textbook very closely. My posted lecture notes will be the main text. The textbook by Zee is wonderful and you should all keep it by your bedside. I will sometimes refer you to some relevant sections of the following books.

*Quantum Field Theory in a Nutshell*, by Anthony Zee (Princeton) (electronic version through UCSD library [here](#)).

*An Introduction to Quantum Field Theory*, by Michael Peskin and Daniel Schroeder (Wiley).

*Quantum Field Theory: an integrated approach*, by Eduardo Fradkin (Princeton).

*Quantum Field Theory and the Standard Model*, by Matthew D. Schwartz (Cambridge).

*A Modern Introduction to Quantum Field Theory*, by Michele Maggiore (Oxford).

*The quantum theory of fields, vol. 1: foundations* by Steven Weinberg (Cambridge) (electronic version through UCSD library [here](#)).

Finally, a great and freely-available resource is [David Tong's lecture notes](#).

### **Grading:**

Grades will be determined by problem sets, class participation, and take-home final.

### **Problem sets:**

Problem sets are a very important part of this course. Sitting down yourself and trying to reason your way through a problem not only helps you learn the material deeply, but also develops analytical tools fundamental to a successful career in science. I recognize that students also learn a great deal from talking to and working with each other. I encourage each student to make his/her own attempt on every problem and then, having done so, to discuss the problems with one another and collaborate on understanding them more fully. Such collaboration adds most to the understanding of those participants who have done the most by themselves first. The solutions you write up after any discussion and then submit must reflect your own work. They must not be transcriptions or reproductions of other people's work.

It may be possible to find solutions to some of the problems on the internet. I very strongly encourage you to resist the temptation to look for such solutions, for the reasons given in the previous paragraph. The solutions I have written for past years' problem sets have very specific errors sprinkled throughout that identify them uniquely. It would make me extremely unhappy to find these errors in your solutions.

In doing the problems, you should feel free to use whatever computational software (*e.g.* *Mathematica*) you find useful; please make a note in your write-up when you do so.

Problem sets will be posted on the course web page

<http://mcgreevy.physics.ucsd.edu/f23/hw.html> .

They will be approximately weekly and generally be due at the beginning of lecture.

### **Homework hand-in procedure:**

- Homework will be handed in electronically. The preferred option is to typeset your homework. It is easy to do and anyway as a practicing scientist you will need to be comfortable quickly producing readable documents. A LaTeX template file with some examples is provided [here](#). If you need help getting set up or have any other questions please email me.
- To hand in your homework, please submit a pdf file through the course's canvas website (at [canvas.ucsd.edu](http://canvas.ucsd.edu)) under the appropriate assignment, hwnm (where *nm* are the decimal digits of the assignment number).

Thanks in advance for following these guidelines. Please ask me if you have any trouble.

**Miscellaneous unsolicited advice about how to do well in this class:**

Participate in lecture! I will post my lecture notes, but they are intended as a supplement to what is presented in lecture, not a substitute.

Keep up with the material. Review the lecture notes from previous lectures before the next one. The relevant reading from other sources always appears at the beginning of a section of the lecture notes; read ahead.

Start the homework problems as early as possible. Give yourself some time to think about them, and keep them in mind when you are reading and in lecture.

Ask lots of questions (during lecture, by email, during office hours). I particularly encourage and enjoy questions by email and will do my best to answer them promptly. The fact that you can ask questions is the point of having classes and not just having everyone go learn on their own.