Physics 33-770
Field Theory I
Fall 2019
Carnegie Mellon University

Meeting Times and Places

Classes:	MWF	11:30am to 12:20pm	DHA325

Instructor: Prof. Colin Morningstar

Office: Wean Hall 8420
Phone: (412) 268-2728
e-mail: cmorning@andrew.cmu.edu
Course web site: `http://www.cmu.edu/canvas`

Course Overview:

This is a first course in relativistic classical and quantum field theory. Topics include the Lagrangian and Hamiltonian formulations of classical field theory, including Poincaré symmetry and Noether currents, and the canonical and path integral quantization of fields. The Klein-Gordon, Dirac, and photon fields, are studied. Feynman diagram techniques and methods of renormalization in interacting field theories are detailed.

Office Hours:

Open-door policy during normal working hours; questions by email or through canvas welcome any time.

Textbook:

There is no textbook for this course; lecture notes will be provided. A list of useful references is given below.

Course Objectives

By the conclusion of this course, you should have developed:

- an appreciation for and understanding of elementary particle dynamics and their interactions and the need for quantum field theory to describe them.
- an appreciation of the physical motivations behind both classical and quantum field theories, as well as their symmetries and the repercussions of these symmetries.
- an ability to calculate the n-point functions of a quantum field theory using renormalized perturbation theory and Feynman diagrams

Grading Overview:

Your final grade will be based on weekly assignments, participation (including attendance), in-semester short quizzes, and a final examination, weighted as follows:

Weekly Assignments	50%
In-semester Quizzes	10%
Participation	5%
Final examination	35%

The letter grade cutoffs are A+ 90, A 86, A- 82, B+ 78, B 74, B- 70, subject to small adjustments.

Weekly Assignments and Participation:

Problem sets will be assigned each week which will appear on the course Canvas web site. You will have about one week to complete each problem set and hand it in for credit. The due date for each assignment will be indicated on the assignment and in Canvas. There will be a 10% deduction for each day late. Incomplete assignments will not be accepted. Even after 10 days late, a fully completed assignment must be turned in, although you will receive a zero score for it. If you do not fully complete all assignments and submit them by the last day of classes, you will receive an R grade. In determining the assignment portion of your final grade, all assignments will be included, weighted according to their total points.

Although you may discuss solution approaches with other students, the work you hand in should represent your own efforts. *Consulting solutions from past courses is a serious academic offense; you will receive an R grade and expulsion is a strong possibility. Don't do it!*

Solutions will be posted on Canvas. If you have not fully understood an exercise, consult the solutions to rectify this. Ask questions until your understanding of each exercise is complete.

The participation part of your grade takes attendance into account, questions asked in and out of class, and attention paid to the provided notes.

In-semester Quizzes and the Final Examination:

A few small in-semester quizzes will be given throughout the semester. You will be informed about each quiz and its topic in the class before it is given. If you must be absent for a quiz, please inform me *before* the quiz so that you can take it before the rest of the class.

The final examination will have a closed-book portion of shorter questions and an open-book portion with more involved questions.

Useful references:

- M. Peskin and D. Schroeder, *An Introduction to Quantum Field Theory* (Westview Press)
- S. Weinberg, *The quantum theory of fields*
- J.D. Bjorken and S. Drell, *Relativistic quantum fields*
- Stefan Pokorski, *Gauge field theories*
- C. Itzykson and J.B. Zuber, *Quantum field theory*
- L.S. Brown, *Quantum field theory*
- A. Zee, *Quantum Field Theory in a Nutshell*
- P. Ramond, *Field theory: A modern primer*
- G. Sterman, *Introduction to quantum field theory*
- M. Srednicki, *Quantum Field Theory*
- S. Schweber, *An introduction to relativistic quantum field theory*
- M. Swanson, *Path integrals and quantum processes*

Special Dates:

Monday, August 26	First day of classes
Monday, September 2	Labor Day (no class)
Friday, October 18	Mid-semester Break (no class)
Friday, October 25	Community engagement (no class)
Wed, Nov 27 - Fri, Nov 29	Thanksgiving Break (no classes)
Friday, December 6	Last day of classes
December TBA	Final examination

Accommodations for Students with Disabilities:

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Student Wellness:

As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. CMU services are available, and treatment does work. You can learn more about confidential mental health services available on campus at: http://www.cmu.edu/counseling/. Support is always available (24/7) from Counseling and Psychological Services: 412-268-2922.