Physics 253a: Quantum Field Theory I

Harvard University, Fall 2022

Instructor: Xi Yin

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Office hours: Tuesdays 3-4pm at Jefferson 570, or by appointment

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Office hours: Fridays 2-3pm at Jefferson 453

Course Description: Path integral formulation of quantum mechanics, Lagrangian perturbation theory, regularization, renormalization, and counter terms. Relativistic particles and field operators. ϕ^4 theory. Green functions. Feynman rules. The S-matrix. LSZ reduction formula. Particles with spin. Fermions. Gauge fields. Quantum electrodynamics and its applications.

Prerequisites: Physics 251a or equivalent

Slack Workspace: harvardqftfall2022.slack.com

All written communication in this course will be conducted through the slack workspace (contact Xi Yin for invitation.)

Lectures: Tuesdays and Thursdays 1:30-2:45pm at Jefferson 356

The lectures will be live streamed over Zoom at the link

https://harvard.zoom.us/j/93664510985?pwd=NW1La1RYcGI2VmpaTW9CQ3pxZmdCQT09

The recording will be posted after each lecture.

Sections: Fridays 10:30am-11:30am at Jefferson 356.

Sections will be live streamed (and recorded) over Zoom at the link

https://harvard.zoom.us/j/91056325144?pwd=aHk0Y3Y2alNvVHdGVVFOS2ZLamcwQT09

Course Requirements and Grading:

Homework: There will be (roughly) biweekly problem sets. You are encouraged to discuss the problem sets but you should write your solutions individually. The problem sets will account for 70% of the grade.

Final Project: You will choose one problem from a list, write up your own solution as a term paper, and give a 30 minute presentation on it. Both understanding the problem and solving it will likely involve reading beyond the lecture material. You may also find the answer in the literature, but your solution should be self-contained. The list of possible problems and references will be handed out during the second half of the semester. The presentations will be held in the reading/exam period, and the term paper is due by the end of the exam period. The term paper and presentation will account for 30% of the grade.

There will be no final exam.

Textbooks: We will adopt the conventions used in Weinberg's *The Quantum Theory of Fields* volume 1 and 2. Hand written lecture notes will be posted as the course proceeds.