Syllabus for Quantum Field Theory II

March 7, 2026

Course

- Course: Quantum Field Theory II
- Semester: Spring 2026
- Course website: https://qudx54632.github.io/qudx.github.io/teaching/qft2/
- Instructor: Dongxue Qu
- Email: `dqu@cdut.edu.cn`
- Office hours: By email appointment
- Emails will normally be answered during regular working hours.

Course Meeting Times

Total lectures: 20.
Class time: Monday and Friday, Periods 3–4 (1.5 hours per lecture).
The first lecture will take place on March 9. The detailed lecture schedule is updated on the course website during the semester.

Prerequisite

Students must complete *Quantum Field Theory I* before taking this course.

Description

Quantum Field Theory II continues the study of relativistic quantum field theory developed in Quantum Field Theory I. The course focuses on fermionic fields, gauge fields, and quantum electrodynamics. Key topics include the quantization of Dirac fields, discrete symmetries, the path integral formulation for fermions, Maxwell theory and its quantization, quantum electrodynamics (QED), quantum fluctuations, and renormalization. The course concludes with an introduction to gauge symmetry and its role in modern particle physics.

Required Textbooks

- Peskin, Michael E., and Daniel V. Schroeder. *An Introduction to Quantum Field Theory*. CRC Press, 1995. ISBN: 9780201503975.
- Zee, A. *Quantum Field Theory in a Nutshell*. Princeton University Press, 2010. ISBN: 9780691140346.

Topics

- Dirac fields
  - Dirac equation and spinor representations
  - Quantization of the Dirac field
  - Fermionic propagators and spin sums

  - Discrete symmetries (C, P, T)
- Path integrals for fermions
  - Fermionic path integrals
  - Grassmann variables
  - Fermionic propagators from functional integrals
- Maxwell theory
  - Classical Maxwell equations
  - Gauge symmetry
  - Canonical quantization of the electromagnetic field
  - Gauge fixing and photon propagator
- Quantum electrodynamics
  - Interaction between Dirac fields and gauge fields
  - Feynman rules for QED
  - Elementary scattering processes
- Quantum fluctuations and renormalization
  - Loop diagrams and quantum corrections
  - Regularization methods
  - Renormalization in QED
  - Physical interpretation of running couplings
- Gauge symmetry
  - Ward identities
  - Introduction to non-Abelian gauge theory

Grading

The course grade will be based on:

- Homework: 30%
- Class participation: 30%
- Final exam: 30%
- Class performance (attendance and engagement): 10%

Final Exam

Date: June 15th
Format: 1 hour 30 minutes open-book examination
Place: 9B204

Homework

Homework will normally be posted on the course website on Friday and will be due on Friday one week later. Any late homework will only be counted as half credit. For example, if you get 90% on a late homework, it will only count as 45%. However, your lowest homework score will be discarded at the end of the semester; only the remaining $n - 1$ will be used in determining your grade.
Homework is a very important part of this course. You are encouraged to work through the problems independently and may discuss them with classmates or consult external resources. However, the solutions you submit must reflect your own work.

They must not copy and paste others' work. **Plagiarism is a serious offense** and is easy to recognize. Do not submit work that is not your own. If plagiarism is detected, the grade for that homework will be 0.