

# QFT Syllabus

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## 1 Classical Field Theory

Lagrangian Field Theory; Lorentz Invariance; Noether's Theorem and Conserved Currents; Hamiltonian Field Theory.

## 2 Canonical Quantization

The Klein-Gordon Equation, The Simple Harmonic Oscillator; Free Quantum Fields; Vacuum Energy; Particles; Relativistic Normalization; Complex Scalar Fields; The Heisenberg Picture; Causality and Propagators; Applications; Non-Relativistic Field Theory

## 3 Interacting Fields

Types of Interaction; The Interaction Picture; Dyson's Formula; Scattering; Wick's Theorem; Feynman Diagrams; Feynman Rules; Amplitudes; Decays and Cross Sections; Green's Functions; Connected Diagrams and Vacuum Bubbles; Reduction Formula

## 4 The Dirac Equation

The Lorentz Group; Clifford Algebras; The Spinor Representation; The Dirac Lagrangian; Chiral Spinors; The Weyl Equation; Parity; Majorana Spinors; Symmetries and Currents; Plane Wave Solutions.

## 5 Quantizing the Dirac Field

A Glimpse at the Spin-Statistics Theorem; Fermionic Quantization; Fermi-Dirac Statistics; Propagators; Particles and Anti-Particles; Dirac's Hole Interpretation; Feynman Rules

## 6 Quantum Electrodynamics

Gauge Invariance; Quantization; Inclusion of Matter – QED; Lorentz Invariant Propagators; Feynman Rules; QED Processes.