

832 Syllabus (Spring, 2007):
Quantum Field Theory II

1 Radiative Corrections I (Chapt.6)

1.1 Bremsstrahlung

1.2 Electron-Photon Vertex Corrections

- a. The electron-photon vertex function
- b. Regularization of divergences
- c. The vertex corrections

1.3 Soft Photon Summation

2 Radiative Corrections II (Chapt.7)

2.1 One-Particle Irreducible Diagram

2.2 The Electron Self-Energy

- a. 1-loop electron self-energy
- b. Mass renormalization
- c. The Ward-Takahashi identity

2.3 Vacuum Polarization

- a. 1-loop vacuum polarization
- b. Charge renormalization
- c. Radiative correction to the Coulomb law
- c. Electron-positron pair creation

2.4 Summary of QED Renormalization

- a. QED renormalization at 1-loop
- b. Conceptual remarks on renormalization

- 3 Functional Methods (Chapt.9)
 - 3.1 Path Integral in Quantum Mechanics
 - 3.2 Quantization for Scalar Fields
 - 3.3 Quantum Field Theory and Statistical Mechanics
 - 3.4 Quantization for Electromagnetic Field
 - 3.5 Quantization for Spinor Fields
- 4 Renormalization Group (Chapts.8,12,13)
 - 4.1 Callan-Symanzik Equation
 - 4.2 Evolution of coupling constants
 - 4.3 Wilsonian Approach to Renormalization Theories
 - 4.4 Critical Phenomena
- 5 Non-Abelian Gauge Theories (Chapt.15,16,17)
 - 5.1 Quantization of Non-Abelian Gauge Fields
 - 5.2 Ghosts and Unitarity
 - 5.3 Quantum Chromodynamics: QCD
 - 5.4 Asymptotic Freedom
 - 5.5 Quantum Field Theory on a Lattice
- 6 Anomalies and symmetries (Chapt.19)
- 7 Gauge Theory with Spontaneous Symmetry Breaking (chapts.11,20)
 - 7.1 The Goldstone Theorem
 - 7.2 The Higgs Mechanism
 - 7.3 The Standard Model of Strong-Electroweak Interactions