School of Mathematics

Course 444 — Quantum Field Theory 2008-09
(SS Theoretical Physics, SS Mathematics)

Lecturer: Prof. Samson Shatashvili

Requirements/prerequisites: 441, 432

Duration: 19 weeks

Number of lectures per week: 3

Assessment: Regular assignments.

End-of-year Examination: One 3-hour examination (upon which final grade is based).

Description:

- Elements of classical field theory: Lagrangian and Hamiltonian formalisms, Noether theorem, Conservation laws,
- The Klein-Grodon (KG) field in space-time,
- quantization of KG field,
- the Dirac field,
- quantization of Dirac field,
- interacting fields and Feynman diagrams
- Feynman diagram formalism for scalar ϕ^4 theory
- Feynman rules for Quantum Electrodynamics (QED),
- Elementary processes of QED,
- S-matrix: Scattering and decay,
- Trace technology,
- Crossing symmetry,
- Radiative corrections: Infrared and Ultraviolet divergencies, Loop computations, LSZ reduction formula, Optical theorem, Ward-Takahashi identities,
- renormalization of electric charge.

Textbooks:

1. Michael E. Peskin, Daniel V. Schroeder, "An introduction to quantum field theory," HarperCollins Publishers; Reissue edition (1995)

2. Paul A. M. Dirac, "Lectures on Quantum Mechanics," Dover Publications (2001)

3. Mark Srednicki, "Quantum Field Theory," Cambridge University Press (2007) (you can download a pdf file of this book from `http://www.physics.ucsb.edu/~mark/qft.html`)

Recommended:

1. Steven Weinberg, "The quantum theory of fields. Vol.1,; Foundations," Cambridge University Press (1995)

2. N.N. Bogoliubov and D.V. Shirkov, "Introduction to the theory of quantized fields," John Wiley & Sons (1959)

3. Francis Halzen and Alan D. Martin, "Quarks and Leptons: An Introductory Course in Modern Particle Physics," Wiley (1984)

4. James D. Bjorken, Sidney D. Drell, "Relativistic Quantum Mechanics" (International Series in Pure & Applied P), McGraw-Hill College (1965)

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