**Renormalization and the renormalization group**
**Summary of the course**
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- Introductory steps:
  Fundaments of gauge theories; abelian case:QED; non abelian case: Yang-Mills theories. Path integral, Green functions and derivation of Feynmann rules for gauge thoeries. Several examples have been worked out: propagator of a scalar field, propagator of a gauge vector boson, photon-electron interaction vertex in QED. Introduction of Grassmann algebra.

- Dimensional regularization:
  Calculation of loop integrals in $D = 4 - 2\epsilon$ dimensions. Feynmann parametrization. Calculation of the electron self-energy.

- Renormalization:
  Definition of renormalizable interactions. Superficial degree of divergence, index of divergence. Index of divergence for QED and QCD interaction terms. Renormalization schemes. Renormalization constants. Calculation of the electron field renormalization constant. Ward identities. QCD and Slavnov-Taylor identities. Brief introduction to BRS symmetry.

- Renormalization group:
  Renormalization group functions. Renormalization group equations and their properties in the $MS$ and $\overline{MS}$ schemes. 't Hooft and Weinberg equation. Behaviour of the solution. Asymptotic freedom in QCD. Meaning of the anomalous dimensions.

The reference texts are:
T. Muta, *Fundations of Quantum Chromodynamics*,
Peskin and Schroeder, Introduction to Quantum field theory.