



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Teoria Quantistica dei Campi II

2223-1-F1701Q134

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#### Aims

Complete the study of QFTs by developing the functional approach to gauge theories, which describe fundamental interactions. Deepen the knowledge of the main properties of QED and QCD. Become familiar with advanced topics in QFT.

#### Contents

Functional approach to gauge theories. Perturbative renormalization of QED and QCD. Renormalization group for gauge theories. Anomalies.

#### Detailed program

Wilsonian effective action. Classification of composite operators.

Functional methods for fermions. Integration on grassmannian variables. Yukawa theory: one-loop renormalization.

Discrete symmetries: parity, time-reversal, charge conjugation. PCT theorem.

Gauge theories. Yang-Mills theories. Path integral formulation. Abelian and non-abelian cases.

Propagator of the gauge fields. Gauge fixing, Faddeev-Popov determinant and corresponding ghosts. BRST quantization.

Perturbative approach to path integral for gauge theories with scalar and fermionic matter. QED: Renormalization

and beta functions for QED and QCD. Asymptotic freedom. Banks-Zaks fixed point.

Renormalizability of gauge theories with spontaneous symmetry breaking. Renormalizable gauges vs unitary gauge.

Symmetries, Ward-Takahashi and Slavnov-Taylor identities. The case of QED and QCD.

Anomalies in QFT. Axial and chiral anomalies. Triangle anomaly. Fujikawa's method.

## **Prerequisites**

General Relativity, Theoretical Physics I,II, Quantum Field Theory I

## **Teaching form**

Frontal lectures

## **Textbook and teaching resource**

M.E. Peskin, D.V. Schroeder, An introduction to Quantum Field Theory

P. Ramond, Field Theory : A Modern Primer, 2nd Edition

M. Srednicki, Quantum Field Theory

T-P. Cheng and L-F. Li, Gauge Theory of Elementary Particle Physics

D. Anselmi, Renormalization

S. Weinberg, The Quantum Theory of Fields I, II

## **Semester**

Second semester

## **Assessment method**

Oral exam preceded by a short exercise to be solved in presence.

The final evaluation will take into account the level of comprehension of all the topics introduced in the course, the level of computational skills in QFT acquired, as well as scientific language skills and clarity of the answers.

## **Office hours**

By appointment, sending an e-mail to [silvia.penati@unimib.it](mailto:silvia.penati@unimib.it)

## **Sustainable Development Goals**

QUALITY EDUCATION

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