

Prerequisites:

PHY681

Arjun Bagchi

PHY781: Quantum Field Theory - II

Evaluation: 4 Assignments + 1 Take Home exam (24 hrs.)

= 50%, Mid.Sem. Project: reports = 10%, 30 min. talk = 40%

TUE : 17:15 - ...

WED : 12:00 - 13:30

THU : 17:15 - ...

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Summary: This is the second course on Quantum Field Theory (QFT). QFT is one of the fundamental tools of modern physics with broad ranging applications in all of theoretical physics including condensed matter physics, particle physics and other areas of high energy physics.

This course is structured as follows: we first briefly cover quantization of constrained systems, and rederive the aspects of Quantum Electrodynamics. We then consider classical aspects of abelian and non-abelian gauge theories. The second part introduces the path integral formulation and reconsiders the quantization of scalar, fermionic and electromagnetic theories in this formulation. We then use this method for Yang-Mills theories. The last part of the course deals with renormalization. Answers to various processes in QFT often turn out to be infinite. Regularization and renormalization are used to extract physical answers out of these infinities. This course will lay out the formal procedures and show how to renormalize various QFTs.

Topics to be Covered

1. Quantization of constrained systems
 - a) Classification of constraints
 - b) Dirac method of quantization
2. Classical aspects of gauge theories
 - a) Non-abelian gauge theories → used to understand the strong and weak interactions
3. Functional methods
 - a) Path integrals for quantum mechanics
 - b) Path integral quantization of scalar fields, fermions and electrodynamics
4. Quantization of Yang-Mills theories
 - a) Path integral quantization for non-abelian gauge theories, Fadeev-Popov ghosts
 - b) BRST quantization

5. Renormalization
 - a) Systematics of renormalization
 - b) Renormalization group

References:

1. M Peskin and D Schroder - *An Introduction to Quantum Field Theory*
2. S Weinberg - *The Quantum Theory of Fields: Vol-1 and Vol -2*
3. Ashok Das - *Lectures on Quantum Field Theory*
4. M Srednicki - *Quantum Field Theory*
5. L Ryder - *Quantum Field Theory*
6. A Zee - *Quantum Field Theory in a Nutshell*