First Course Handout
PHY 681 - Quantum Field Theory

2022-2023 : Semester-I

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An introductory course on Quantum Field Theory (QFT)
aimed at Master's level and beginning PhD students.

- **Prerequisite** : Quantum Mechanics II (PHY432).
  Additionally, students should have good understanding of Lagrangian mechanics of point particles, special theory of relativity and mathematical methods.

- **Plan of the course** : The following topics will be covered in the course:

  1. *Elements of classical field theories* : Lagrangian formulation, Lorentz invariance, Symmetries, Noether's theorem and conserved currents.
  2. *Second quantization* :
     The basic framework for the formulation of many-body quantum systems.
  3. *QFT with scalar fields* :
     (a) Free scalar fields : Klein-Gordon equation, canonical quantization, propagators.
     (b) Interacting scalar fields : Wick's theorem, Feynman rules.
  4. *QFT with fermionic fields* :
     Spinors in Lorentz group, Dirac equation, canonical quantization.
  5. *QFT with gauge fields* : Gauge symmetries, quantum electrodynamics (QED), canonical quantization, Feynman diagrams.

- **References** : No textbook will be strictly followed. The following textbooks will be useful for the contents of the course.

  - M. Peskin and D. Schroeder, *An Introduction to Quantum Field Theory*
  - L. Ryder, *Quantum Field Theory*
  - A. Zee, *Quantum Field Theory in a Nutshell*
  - M. Srednicki, *Quantum Field Theory*

- **Grading/Evaluation Policy** : Evaluation will be based on assignments, class tests, mid-semester and end-semester examinations.