PHY781: High Energy Physics-II, First Course Handout, Semester 2025-26-II

Instructor : Diptarka Das

This is the second course on Quantum Field Theory which will deal with key formal developments and features of the QFT formulation.

Lecture outline: $39 \times (t_1 = 50 \text{ Minutes}) = 26 \times (t = 75 \text{ Minutes})$.

Topics	**Details**	t
Path integrals & Diagrammatics	Coherent states for bosons and fermions, Reviews of 1PI & LSZ reduction	2
Encountering ∞	QM example, ϕ^4 theory, electron self-energy, vertex correction in QED, Vacuum polarization	7
Wilsonian Renormalization	Wilson-Fischer fixed point, Comparison with counterterms, operator product expansion, critical exponents, composite operator renormalization, Callan-Symanzik equation	9
Unitarity	Spectral density, Cutting rules, Optical theorem, Dispersion relations	2
Gauge Theory	Anderson-Higgs and superconductors, Non-Abelian gauge fields, Gauge-fixing, Ghosts, BRST, Computation of QCD β-function	6

Pre-requisites: PHY685: Quantum field theory - 1.

Evaluations[1] **:** Assignments [25%]. Midsemester examination [35%] and Endsemester examination [40%].

References :

1. *Quantum Field Theory Volume 1 & 2* , S. Weinberg **2.** *Quantum Theory of Many-variable Systems and Fields*, B. Sakita **3.** *Quantum Field Theory in a Nutshell*, A. Zee, **4.** *Quantum Field Theory*, M. Srednicki, **5.** *An Introduction to Quantum Field Theory*, D. V. Schroeder and M. Peskin.

---

[1] To be finalized after assessing number of students in class