Physics Department **IIT Kanpur**

Course Title: **Quantum Many Body Physics** (PHY607)
Units : 3-0-0-9
Instructor: Arijit Kundu (kundua@iitk.ac.in)

Course Description: This will be an introductory course on many-body techniques in condensed matter. You expect to learn and use quantum field theoretic application in interacting quantum systems, focused on solid-state applications.

Pre-requisites: Essentials: PHY431, PHY412, PHY543. Knowledge of scientific computing. Good grades in PHY431, PHY412 and PHY623 are important.

Outline of course content:

- Second quantization and coherent states.
- Functional path-integral
- Perturbation theory: finite temperature and zero temperature.
- Order parameters and broken symmetry: mean-field theories and fluctuations.
- Linear response theory and use of Green's function.
- Landau theory of Fermi liquids*.
- Ideas of Luttinger liquid*.
- Introduction to non-equilibrium Green's functions*.

(* if time permits/as reading projects)

Home Assignments:
Home Assignments (HA) will be given regularly. The students are strongly advised to solve the questions. The submission of HA for correction is optional.

Exams and Quizzes :
Tentative weightage of marks are following: **Assignment submission: 25, Midsem: 25, Endsem: 50.**

A student is expected to do well if she/he follows regular classes, assignments and tutorials.

References:

I recommend the student to take regular class notes, as it is difficult to find a single book that covers all the chapters in the way the course will follow. Below are general references:

1. Condensed Matter Field Theory, A. Altland and B. Simon, Cambridge University Press.
2. Quantum Many-Particle Systems, J. W. Negele and H. Orland.
3. Introduction to Many-Body Physics, P. Coleman, Cambridge University Press.