Harvard University

# Physics 295b: Quantum Theory of Solids

*Instructor : Subir Sachdev, Lyman 343, sachdev@g.harvard.edu*

*Fall 2016 Wed, Fri 3:00-4:30 pm, J356*

*All class materials can be obtained from https://canvas.harvard.edu/courses/16134*
The first class will meet on Friday Sep 2. (because Wed Aug 31 is on a Monday schedule) Make-up classes will also meet occasionally on Mon 3:00-4:00. Please see the schedule of classes under "Anouncements"

*Teaching fellow: Aavishkar Patel, apatel@physics.harvard.edu*

A course on the application of the principles of many-particle quantum mechanics to the properties of solids. The objective is to make students familiar with the tools of second quantization and diagrammatic perturbation theory, while describing the theory of the electron liquid and the BCS theory of superconductivity. Modern topics related to current research on correlated electron systems will occupy the latter part of the course. A tentative outline is:

1. Hartree-Fock theory of the electron gas
2. Ferromagnetism and mean-field theory
3. Linear response theory and spectral functions.
4. Time-dependent Hartree-Fock and screening in the electron gas.
5. Perturbation theory and Feynman diagrams.
6. BCS theory of superconductivity.
7. Fermi liquid theory.
8. Lattice models of correlated electrons: antiferromagnetism
9. Local moments, Kondo effect, and heavy-electron metals

Prerequisite: Physics 251a,b, an introductory course in solid state physics, or permission of instructor

There will be regular homework assignments. There will be no final exam. The final project will be an in-class presentation of a recent paper from the literature.

The text book for the course is

- *Introduction to Many-Body Physics*, by Piers Coleman, QC174.17.P7C64

Useful references covering similar material are:

- *Many-Body Quantum Theory in Condensed Matter Physics, An Introduction*, by H. Bruus and K. Flensberg, QC 174.5 .B89 2004
- *Quantum many-particle systems*, John W. Negele, Henri Orland. QC174.17.M3 N384
- *A Quantum Approach to Condensed Matter Physics*, by P. L. Taylor and O. Heinonen, QC 173.454 .T39 2002.
- *Quantum theory of the electron liquid*, by G. Giulani and G. Vignale, QC174.85.F47 G48 2005