PH320 Aug 3:0

Consensed matter Physics II

Instructor

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Department: Physics

Course Time: Tue.,Thu., 5.00-6.30 pm.

Lecture venue: Auditorium, New Physical Science Building

Detailed Course Page: https://sumilanbanerjee.wixsite.com/mysite/ph320-condensed-matter-physics-ii

Announcements

Brief description of the course

The course is offered to the phd, integrated phd and 4th and 5th year undergraduate students. It aims to introduce the students to the advanced topics in condensed matter physics, e.g. physics of interacting electronic systems.

Prerequisites

Quantum mechanics, basics statistical physics and condensed matter physics I (or equivalent solid state physics course).

Syllabus

Review of one-electron band theory. Effects of electron-electron interaction: Hartree â€“ Fock approximation, exchange and correlation effects, density functional theory, Fermi liquid theory, elementary excitations, quasiparticles. Dielectric function of electron systems, screening, plasma oscillation. Optical properties of metals and insulators, excitons. The Hubbard model, spin-and charge-density wave states, metal-insulator transition. Review of harmonic theory of lattice vibrations. Anharmonic effects. Electron-phonon interaction â€“ phonons in metals, mass

renormalization, effective interaction between electrons, polarons. Transport phenomena, Boltzmann equation, electrical and thermal conductivities, thermo-electric effects. Superconductivityâ€“phenomenology, Cooper instability, BCS theory, Ginzburg-Landau theory.

Course outcomes

The student will learn the basics techniques to deal with interacting quantum systems, e.g. mean field theory, second quantized operators. Also transport and linear response theories that connect between theory and experimental observations are taught. It introduces theoretical framework such as BCS theory of superconductivity.

Grading policy

40% assignments, 15% mid-term, 20% project (term paper) and 25% final exam.

Assignments

Resources

1. Ashcroft, N.W., and Mermin, N.D., Solid State Physics, Saunders College, Philadelphia.
2. Madelung, O., Introduction to Solid State Theory, Springer-Verlag, Berlin.
Jones, W., and March, N.H., Theoretical Solid State Physics, Dover Publications, New York.
3. Philip Phillips, Advanced solid state physics.
4. Giuliani and Vignale, Quantum theory of the electron liquid.
5. P. Fazekas, Lecture notes on electron correlation and magnetism.
6. A. Altland and B. Simons, Condensed matter field theory.
7. P. W. Anderson, Basic notions of condensed matter physics