

IIT Mandi

Proposal for a New Course

Course Name : Special Topics on Correlated Electron Systems
Course Number : PH 591
Credits : (1-0-0-1)
Prerequisites : Quantum mechanics (PH301), Condensed matter physics (PH 501)
Intended for : I-Ph.D., M.Sc., B.Tech 3rd and 4th Year.
Distribution : **Elective** for I-Ph.D., M.Sc., B.Tech 3rd and 4th Year
Semester : odd
Preamble : The objective of the proposed course is to introduce students to the concepts of electron correlation and many-body phenomena in solids.

Course Outline : The course begins with an introduction to phenomena in solids beyond single-particle quantum theory. Then it introduces second quantization and basic many-body techniques. Fermi-liquids are introduced. Specific and well-known examples of correlated phenomena are discussed: from magnetic impurities it develops the notion of renormalization. Correlated models like Hubbard and t-J model are discussed in the backdrop of correlated systems. Different approximate methods for such models are introduced.

Modules :

Basic phenomena and techniques: Physics beyond independent electrons. Instabilities of the Fermi-surface, second quantization and many-body physics, Green's function, quasi-particles and Landau theory.

[2 lectures]

Correlated models: Magnetic impurity, Kondo physics, idea of renormalization. Heavy fermions and cuprates. Falicov-Kimball, Hubbard and t-J model. Hubbard model: one-site and two-site-two-electron solutions. Mott transition. - Approximate methods: mean-field, Hubbard approximation, slave fermions, Gutzwiller approximation, Brinkmann-Rice approach. D-infinity and numerical methods.

[8 lectures]

Correlation and magnetic field: Fractional quantum Hall effect, Laughlin's idea, composite fermions.

[2]

One quiz and one exam [2 hours]