

PHY611: Advanced Solid State Physics I**2 CH (L30+T10)**

Nature of the course: Theory

Full Marks: 50

Pass Marks: 25

Course Description:

This course aims at providing students with basic knowledge and skill in theoretical as well as experimental aspects of Solid State Physics.

Objectives:

- To acquaint student with the theoretical and experimental methods in Solid State Physics.
- To prepare them in developing skill to pursue further study and research in the field of physics.

Course Content:

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| 1. Introduction: | [2 hours] |
| 1.1 Non-interacting Electron Gas | |
| 2. Born-Oppenheimer Approximation: | [3 hours] |
| 2.1 Basic Hamiltonian | |
| 2.2 Adiabatic Approximation | |
| 2.3 Reduced electron problem | |
| 3. Second Quantization: | [5 hours] |
| 3.1 Bosons | |
| 3.2 Fermions | |
| 3.3 Fermion operators | |
| 4. Hartree-Fock Approximation: | [4 hours] |
| 4.1 Noninteracting limit | |
| 4.2 Hartree-Fock Approximation | |
| 4.3 Diagrams | |
| 5. Interacting electron gas: | [4 hours] |
| 5.1 Uniform electron gas | |
| 5.2 Hartree-Fock excitation spectrum | |
| 5.3 Cohesive energy of metals | |
| 6. Local magnetic moments in metals: | [4 hours] |
| 6.1 Local moments: Phenomenology | |
| 6.2 Mean-field solution | |
| 7. Quenching of local moments: | [8 hours] |
| 7.1 The kondo problems | |
| 7.2 Kondo Hamiltonian | |
| 7.3 why is J negative? | |
| 7.4 Scattering and resistivity minimum | |
| 7.5 Electron-impurity scattering amplitude | |
| 7.6 Kondo temperature | |

7.7 Poor man's scaling

Text Book:

1. Philip Phillips – **Advanced Solid State Physics**, Cambridge university Press, 2nd ed., Cambridge (2012)

Reference Books:

1. Taylor Philip & Heinonen Olle – **Quantum approach to condensed matter physics**, Cambridge university Press, (2002).
2. Altland Alexander and Simons Ben – **Condensed matter field theory**, Cambridge university Press, south asian ed. (2008).
3. Wen Xiao-Gang – **Quantum field theory of many-body systems**, Oxford university Press, New York (2004).
4. Mahan Gerald – **Many-particle Physics**, 3rd edition, Springer (India), Pvt. Ltd., New Delhi (2008).