Elective Courses - List A

PHY 661 - Advanced Solid State Physics

Course Code & Number	Course Name	C.H.	Lec.	Lab.	Tut.
PHY 661	Advanced Solid State Physics	4	4	0	0

Syllabus

The Drude's Theory of Metals: *Basic assumptions of the model, Collision or relaxation times, DC electrical conductivity, Hall effect and magnetoresistance, AC electrical conductivity, Dielectric function and plasma resonance, Thermal conductivity, Thermoelectric effects.*
The Sommerfeld Theory of Metals: *Fermi-Dirac distribution, Free electrons, Density of allowed wave vectors, Fermi momentum, energy, and temperature, Ground-state energy and bulk modulus, Thermal properties of a free electron gas, Sommerfeld theory of conduction, Wiedemann-Franz law.*
Crystal Lattice: *Bravais Lattice and primitive vectors, Simple, body-centered, and face-centered cubic lattices, Primitive unit cell, Wigner-Seitz cell, and conventional cell, Crystal structures and lattices with bases, Hexagonal close-packed and diamond structures, Sodium chloride, Cesium chloride, and Zincblende structures.*
The Reciprocal Lattice: *Definitions and examples, First Brillouin zone, Lattice planes and Miller indices.*
Determination of Crystal Structures by X-Ray Diffraction: *Formulation of Bragg and von Laue, The Laue condition and Ewald's construction, Experimental methods, Geometrical structure factor, Atomic form factor.*
Classification of Bravais Lattice and Crystal Structures: *Symmetry operations and the classification of Bravais lattices, The seven crystal systems and fourteen Bravais lattices, Crystallographic point groups and space groups, Schoenflies and international notations, Examples from elements.*
Electron Levels in a Periodic Potential: *The periodic potential and Bloch's theorem, Born-von Karman boundary condition, A second proof of Bloch's theorem, Crystal momentum, band index, and velocity, The Fermi surface.*
Electrons in a Weak Periodic Potential: *Perturbation theory and weak periodic potentials, Energy levels near a single Bragg plane, Illustration of extended-, reduced-, and repeated-zone schemes in one dimension, Fermi surface and Brillouin zones, Geometrical structure factor, spin-orbit coupling.*
Beyond the Independent Electron Approximation: *The Hartree equations, The Hartree-Foch equations, Correlation, The dielectric function, Fermi liquid theory.*
Classification of Solids: *The spatial distribution of valence electrons, Covalent, molecular, and ionic crystals, The alkali halides, Ionic radii, metals.*
Cohesive Energy: *The noble gases, Ionic crystals, Cohesion in covalent crystals, Cohesion in metals.*

References

- N.W. Ashcroft, N.D. Mermin, Solid State Physics, Harcourt College Publishers, 1976.
- P. Phillips, Advanced Solid State Physics, 2nd Edition, Cambridge University Press, 2012.
- C. Kittel, Introduction to Solid State Physics, 8th Edition, John Wiley and Sons, 2005.