

# Condensed Matter Physics - Video course

## COURSE OUTLINE

This is an advanced course on condensed matter physics at postgraduate level and it is proposed to introduce students of physics to various fundamental concepts of condensed matter physics and materials science.

Starting with an introduction to symmetry in crystals and phase transitions, the course will cover concepts of waves in periodic structures, vibrations of crystal lattices, free electron theory, band structure, optical, transport, dielectric and magnetic properties of metals, semiconductors, insulators and superconductors.

Noncrystalline solids, defects in solids and quantum fluids will also be briefly discussed.

## COURSE DETAIL

| Topics   | No. of Lectures<br>1 hr each |
|--|------------------------------|
| Symmetry and Physical Properties of Crystals Point groups, Bravais lattices, Space groups, Neumann's Principle and tensor properties of crystalline solids, elements of group theory, diffraction of waves in periodic structures.   | 8                            |
| Vibrations of crystal lattices, phonons and Debye theory of specific heats, thermal expansion and thermal conductivity.  | 8                            |
| Free electron theory, Band structure of solids, metals, insulators and semiconductors, intrinsic and doped semiconductors, effective mass, electrons and holes, Hall effect and cyclotron resonance, galvanomagnetic phenomena, carrier lifetime, semiconductor devices.   | 8                            |
| Dielectric solids, polarization, polarizability, susceptibility, polar and nonpolar dielectrics, dispersion and absorption, electronic, ionic and orientational polarizabilities.<br><br>Magnetism, para, dia and ferromagnetic solids, exchange interactions and antiferromagnetism, magnetic ordering, spin waves. | 8                            |
| Superconductors, London theory, Ginsburg- Landau theory and BCS theory, High temperature superconductors, superfluidity and quantum fluids.  | 4                            |
| Noncrystalline solids, scaling theory and weak localization, defects in solids, point defects and dislocations.  | 4                            |



NP-TEL

# NPTEL

<http://nptel.iitm.ac.in>

## Physics

### Pre-requisites:

Basic Physics at postgraduate level.

### Coordinators:

**Prof. G. Rangarajan**  
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**References:**

1. *Introduction to Solid State Physics*, C. Kittel.
2. *Solid State Physics*, N.W. Ashcroft and N.D. Mermin.
3. *Principles of the theory of Solids*, J. M. Ziman.
4. *Solid State Physics, An introduction to the Principles of Materials Science*, H. Ibach and H. Luty.
5. *Materials Science*, M. S. Vijaya and G. Rangarajan, Tata- McGraw Hill, 2004.