

**Brief description of Advanced Condensed Matter Physics course
at the school of physics, IPM**

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Condensed matter physics deal with the physical properties of materials in which many particles interact to each other. The study of condensed matter physics involves measuring various material properties via experimental probes along with using techniques of theoretical physics to develop mathematical models that help in understanding physical behavior. Basically, in the condensed matter physics, we deal with almost all materials around us by asking many questions about materials that you can feel, manipulate, change, perturb and built. Intriguingly, many of the materials first studies by condensed matter physicists are now the basis of modern technology.

Classically, we learnt of many phases of materials such as liquid, solid or vapor but the quantum world holds many more fascinating mysteries such as superconductors, charge/spin density waves, Bose-Einstein condensates which the underlying principle for characterizing the state is that of symmetry breaking with an order-parameter. In the past decade, it has become clear that a series of phases of matter with named topological order do not have a local order parameter. Recently, topological phases have been pursued because of their potential practical applications. In this course, we hope to review and understand the physical properties and distinctive exotic quantum phases of advanced materials.

In this course, we will be following two books:

- 1) **Advanced Solid State Physics, by Philip Phillips, Second Edition, Cambridge 2012**
- 2) **Topological Insulators and Topological Superconductors, by B. A. Bernevig, Princeton University Press, 2013.**

Prerequisite:

It is assumed that the students are familiar with the basics of *Solid State Physics (as contained, for instance in the book by W. Ashcraft and N. Mermin).*

NOTICE:

- i) For non-IPM students there is the possibility of formally registering for the course as a "guest student". Please arrange the formal details with the physics department office.
- ii) I anticipate that all the students, people who have formally registered or otherwise alike, to attend the lectures regularly and more importantly take the problem sets seriously.
- iii) The classes will be on Sunday and Tuesday morning 10-12 am in Farmanieh Bldg classroom D