

Chapter 0

Introductory Information

Instructor: Daniel Arovas
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Lectures: Tu Th / 11:00 am - 12:20 pm / York Hall 3050B
Office Hours: by appointment

A strong emphasis of this class will be on learning how to calculate. I plan to cover the following topics this quarter:

Transport: Boltzmann equation, transport coefficients, cyclotron resonance, magnetoresistance, thermal transport, electron-phonon scattering

Mesoscopic Physics: Landauer formula, conductance fluctuations, Aharonov-Bohm effect, disorder, weak localization, Anderson localization

Magnetism: Weak vs. strong, local vs. itinerant, Hubbard and Heisenberg models, spin wave theory, magnetic ordering, Kondo effect

Other: Linear response theory, Fermi liquid theory (time permitting)

There will be about six assignments. In lieu of a final examination you will write final paper on a topic you will select from a list I will provide sometime in the middle of the quarter. I will be following my own notes, which are available from the course web site.

0.1 References

- D. I. Khomskii, Basic Aspects of the Quantum Theory of Solids (Cambridge University Press, 2010)
This is listed as the official course text. It will have little overlap with much of the course, but it will be useful when we get to the topic of magnetism. I chose it because it is an excellent text and I may assign some reading and problems from it.
- D. Feng and G. Jin, Introduction to Condensed Matter Physics (I) (World Scientific, Singapore, 2005)
A recent text with a nice modern flavor and good set of topics.
- N. Ashcroft and N. D. Mermin, Solid State Physics (Saunders College Press, Philadelphia, 1976)
Beautifully written, this classic text is still one of the best comprehensive guides.
- M. Marder, Condensed Matter Physics (John Wiley & Sons, New York, 2000)
A thorough and advanced level treatment of transport theory in gases, metals, semiconductors, insulators, and superconductors.
- D. Pines, Elementary Excitations in Solids (Perseus, New York, 1999)
An advanced level text on the quantum theory of solids, treating phonons, electrons, plasmons, and photons.
- P. L. Taylor and O. Heinonen, A Quantum Approach to Condensed Matter Physics (Cambridge University Press, New York, 2002)
A modern, intermediate level treatment of the quantum theory of solids.
- J. M. Ziman, Principles of the Theory of Solids (Cambridge University Press, New York, 1979).
A classic text on solid state physics. Very readable.

- C. Kittel, *Quantum Theory of Solids*
(John Wiley & Sons, New York, 1963)
A graduate level text with several detailed derivations.
- H. Smith and H. H. Jensen, *Transport Phenomena*
(Oxford University Press, New York, 1989).
A detailed and lucid account of transport theory in gases, liquids, and solids, both classical and quantum.
- J. Imry, *Introduction to Mesoscopic Physics*
(Oxford University Press, New York, 1997)
- D. Ferry and S. M. Goodnick, *Transport in Nanostructures*
(Cambridge University Press, New York, 1999)
- S. Datta, *Electronic Transport in Mesoscopic Systems*
(Cambridge University Press, New York, 1997)
- M. Janssen, *Fluctuations and Localization*
(World Scientific, Singapore, 2001)
- A. Auerbach, *Interacting Electrons and Quantum Magnetism*
(Springer-Verlag, New York, 1994)
- N. Spaldin, *Magnetic Materials*
(Cambridge University Press, New York, 2003)
- A. C. Hewson, *The Kondo Problem to Heavy Fermions*
(Springer-Verlag, New York, 2001)