The goal of this two-semester course is to provide a modern introduction to the diverse field of condensed matter physics, for both theorists and experimentalists.

The 1st semester (2018 Fall) covers three aspects:
(1) elementary excitations and how to measure them;
(2) optical properties;
(3) transport properties.

The 2nd semester (2019 Spring) will cover three topics:
(1) magnetism;
(2) superconductivity;
(3) mesoscopic physics.
Instructor: Assistant Professor **Yuan-Ming Lu**

Contact Information:
- Email: lu.1435@osu.edu
- Office phone: 614-292-3084
- Office: 2012 Physics Research Building

Office Hours: Tuesday 8-9AM

Course Location: 2015 Physics Research Building

Course Time: Tuesday and Thursday 9:35AM - 10:55AM

Pre-requisites (recommended):
- Quantum Mechanics 2 (Physics 7502), “Modern Quantum Mechanics” by Sakurai or “Principles of Quantum Mechanics” by Shankar or similar textbooks
- Classical and Statistical Physics II (Physics 7602), Landau-Lifschitz or Pathria-Beale or “Statistical Physics of Particles” by Mehran Kardar or similar textbooks

Textbook:
We do not have a specific textbook for the 2nd semester, but lecture notes will be provided.

Main References:
- *Superconductivity, Superfluids, and Condensates* by James F. Annett (Oxford University Press, 2004)

Other References:
Assignments:
Homework will be assigned roughly every week. Handout on Thursday, due next Tuesday. Since there is no TA, students will be grading each other’s homework.

Term paper:
A term paper in PRL format (not exceeding 4 pages) should be submitted. A number of topics will be suggested in Appendix ???. Different students should choose different topics. Each student will give an oral presentation of about 12 mins (+3 mins questions).

Grading:
Homework $\rightarrow 70\%$; Term paper $\rightarrow 30\%$.

Contents (may evolve with time):
- Magnetic moments
- Crystal fields
- Magnetic resonances
- Magnetic interactions
- Magnetic orders and broken symmetry
- Magnetism in metals
- Magnetism in low dimensionality
• Bose-Einstein condensate and superfluid helium-4
• Phenomenology of superconductivity
• Ginzburg-Landau theory
• Microscopic BCS theory
• Type-II superconductors
• Josephson effects
• Helium-3 and unconventional superconductors
• Quantum confined systems
• Transmission in nanostructures
• Ballistic transport in quantum wires
• Quantum dots
• Weakly disordered systems