

PHY7097: Advanced Topics in Condensed Matter, Fall 2013

Meetings:

Tuesdays and Thursdays 9:35 am – 10:50 am (periods 3 and 4), at NPB 2205

Course Coordinator:

Khandker Muttalib; NPB 2140; Tel: 392-6699; Email: muttalib@phys.ufl.edu

Team of Instructors:

K. Muttalib, S. Hershfield, D. Maslov and K. Ingersent

Objective:

The objective of this course is to provide background and introduction to several current research areas of modern condensed matter physics. This fall, we present four sets of lectures. These represent some of the currently active frontiers of intellectual interest. There are no required textbooks. Lecture notes will be provided if possible. Attendance at all lectures is expected.

Instructor, Course description and Schedule:

The instructors, their topics and the scheduled dates are:

(1) *Schedule:* Aug 22 – Sept 17 (Introduction + 7 lectures)

Instructor: Khandker Muttalib:

Course Topic: Thermoelectric transport in nano-systems

Course Description:

Efficient thermoelectric engines could solve the energy problem of today. While bulk thermoelectric devices have been found to be inherently inefficient, it turns out that nano-engineered devices could make a significant difference. The course will start with a brief review of the standard linear thermoelectric transport in the bulk, and its shortcomings. We will then study the basics of non-linear, non-equilibrium thermoelectric transport in open nano-systems. There will be weekly homework assignments.

(2) *Schedule*: Sept 19 – Oct 10 (7 lectures)

Instructor: Dmitrii Maslov:

Course Topic: Workshop on many-body physics: in-depth solutions of archetypal problems

Course Description:

- (a) Basic Fermi-liquid properties: mass renormalization by electron-electron and electron-phonon interaction, Z-factor, spin susceptibility, etc.
- (b) Migdal theorem for electron-phonon interaction and its consequences.
- (c) Electrons in random potential: Drude conductivity from the Kubo formula, weak localization, Aharonov-Bohm effect, Altshuler-Aronov effect, Kondo effect.
- (d) Basics of renormalization group: 1D electron systems, Kondo.

(3) *Schedule*: Oct 15 – Nov 05 (7 lectures)

Instructor: Selman Hershfield:

Course Topic: An Introduction to Non-equilibrium Green Functions

Course Description:

A non-equilibrium condensed matter model chosen with input from the students registered for the class will be evaluated perturbatively using non-equilibrium green function techniques. We will start by evaluating Feynman diagrams with a review/tutorial for those who are not experienced in this. Then we will specialize to the non-equilibrium case and arrive at a set of integral equations, which will be set up to be evaluated in Matlab. There will be homework after most lectures to complete or extend parts of the calculation, since the best way to learn this material is by doing the calculations oneself.

(4) *Schedule*: Nov 07 – Dec 03 (7 lectures)

Instructor: Kevin Ingersent:

Course Topic: Mini-course on spin-orbit interactions

Course Description:

- (a) Spin-orbit interactions in bulk solids and nanostructures
- (b) Anomalous and spin Hall effects
- (c) Topological insulators
- (d) Spin-orbit interactions and Kondo physics

Grades:

The final grade will be a letter grade computed as an average of grades assigned by the 4 instructors on the basis of stated requirements from each prior to his series of lectures. These requirements may include a short term paper, a presentation to the class, or assigned work outside of class. All writing should be clear and professional.

Special accommodations:

Students requesting classroom accommodation must first register with the Dean of the Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

Academic Honesty:

All University of Florida students are required to abide by the University's Academic Honesty Guidelines and by the Honor Code, which reads as follows:

We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

Cheating, plagiarism, or other violations of the Academic Honesty Guidelines will not be tolerated and will be pursued through the University's adjudication procedures.