Condensed Matter Physics 880.06 Spring Quarter 2010

Instructor: Nandini Trivedi

e: trivedi.15@osu.edu

t: (614) 247 7327

w: http://www.physics.ohio-state.edu/~trivedi

Prerequisites: Quantum Mechanics and Statistical Mechanics

Lecture schedule: T/TH: 1-2:18; W: 4:30-6

Course Contents:

I. Nanophysics

- **(a) Introduction: What is nanophysics?**
- **(b) Self assembled nanostructures in nature**
- **(c) Qubits and quantum dots**
- **(d) Scan Probes**
- **(e) Landauer transport;**
  Connections with Boltzmann transport
- **(f) Coulomb blockade**
- **(g) Spin-Orbit Coupling**
- **(h) FET, Spin injection, Spin FET**
- **(i) Giant Magnetoresistance**
- **(j) Tunneling magnetoresistance**

There is no comprehensive reference.
I will provide references and notes for each section.

II. Superconductivity

(a) Ginzburg-Landau theory, order parameter, broken symmetry, Goldstone modes, rigidity and superfluid stiffness

(b) Type II SC, vortices, quantization of vorticity, H-T phase diagram,

(c) Josephson effect; pair tunneling; SQUIDS; Josephson qubits

(d) XY model; Kosterlitz Thouless transition

(e) Microscopic Theory: Cooper problem; Pairing mechanisms; BCS theory of the SC ground state; Bogoliubov quasiparticles and Thermodynamics; Quasiparticle tunneling; Optical conductivity

(f) Other recent examples: MgB2, High Tc Superconductivity, Fe-based Scs, BCS-BEC Crossover and Cold Atoms

References:

Tinkham "Superconductivity'

Chaikin and Lubensky "Condensed Matter Physics"