PHYSICS 141A – Solid State Physics, Spring 2018

Class Time: Tues/Thurs. 11-12:30 in 9 Lewis.

Instructor: Prof. Mike Crommie. **Office**: 345 Birge. **Phone**: 642-3316
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Text: *Introduction to Solid State Physics, 8th Edition* by C. Kittel, Published by Wiley.

Grading:	Midterm Exam -------------	25%
	Final Exam -----------------	45%
	H. W. -----------------------	30%

H.W. Policy: H.W. will typically be handed out on Monday and collected on Friday at 5pm (box in Birge 465) of the following week. No late H.W. will be accepted (but HW assignments can be dropped for special circumstances, see professor).

Overview of Course Content:

I) Crystal Binding and Structure
II) Reciprocal Lattice and Diffraction
III) Phonons
IV) Electronic Structure
V) Transport and Excitations

Important Note: USE OTHER BOOKS IN THIS COURSE
There is no "one great book" on Solid State Physics. It is imperative that you seek out texts other than the class text to help you understand the concepts and problems.
BEST BOOK STRATEGY: The course will be organized along the lines of Kittel, since I like how that book is organized (for the most part). However, Kittel often doesn't explain things well for the novice. **SO, DO THE FOLLOWING:** read Kittel, and then for the things you don't understand, look them up in Ashcroft and Mermin! Do this and you will learn the subject.
Also Note: The main source for this course is the lectures. **YOU ARE RESPONSIBLE FOR EVERYTHING DISCUSSED IN CLASS**.

Recommended books (in order of preference):

Solid State Physics by N.W. Ashcroft and N. D. Mermin (undergrad./grad level)
Solid-State Physics by H. Ibach and H. Lueth (undergraduate/grad level)
Theory of Solids by Ziman (graduate level)
Solid State Theory by W. Harrison (graduate level)
Condensed Matter Physics by M. P. Marder (undergraduate/grad level)

Detailed List of Topics for 141A Solid State Physics

Bonding, sp^2, sp^3, Van der Waals
crystal structures: cubic, hcp, fcc, bcc
Miller indeces
Reciprocal lattice, diffraction, scattering amplitude
Ewald sphere
Wigner Seitz cell
structure factor
phonons, harmonic approximation
spring model dispersion
allowed modes: longitudinal, transverse, optical, acoustical
phonon scattering
scattering amplitude, G-vectors, quantization
Bose-Einstein distribution function
phonon heat capacity
phonon density of states, different dimensions
T^3 law
Phonon anharmonicity: scattering, thermal expansion
thermal conductivity
Umklapps, temperature dependence of therm. conductivity
Free electron gas
Density of states in k-space
E_F, v_F, k_F, T_F
electron heat capacity
energy density of states
Fermi-Dirac distribution function, chemical potential
Electron transport: conductivity, Hall effect, thermal conductivity
Band structure, central equation, Bloch theorem
Nearly free electron model
bandgaps: Metals vs. Insulators vs. Semiconductors
crystal momentum conservation in transitions
Group velocity, semiclassical model of electron motion
effective mass
holes, semiconductor electronic current
cyclotron resonance
density of holes, chemical potential
Doping, donor and acceptor states, Bohr model for impurities
p-n junction
band bending, depletion region
diode, solar cell, LED
tight binding
screening, dielectric function
Thomas Fermi screening ($\omega=0$)
$\omega\neq0$ screeing: Plasma frequency and dispersion
screening due to ions in polar medium: polariton dispersion