Physics 140A-Introduction to Solid State Physics
Winter, 2016
Problem Set 5
Due anytime from Thursday, March 10th until Thursday, March 17th,
with answers returned by e-mail whenever you turn this in.
Final examination is on Saturday, March 19th

Reading in Omar: Chapter 4--Sections 4.1-4.9, Chapter 5--Sections 5.1-5.8,5.9, 5.11, in 5.4 read on Brillouin zones only, not Symmetry Properties, in 5.6-5.7 don't worry about detailed mathematics
Optional parallel reading in Ibach and Luth: Chapter 6-Sections 6.1-6.4, Chapter 7-Sections 7.1-7.5, and Panel 5. This book presents a more concise version of the same material.

Problems in Omar:
[1] Chapter 4, Problem 1

[2] Chapter 4, Problem 7 (for Cu only)

[3] Chapter 5, Problem 8(a) only. Do this via suitable sketches, not a math. problem.

[4] Chapter 5, Problem 11(a) only.

[5] Chapter 5, Problem 12

[6] Chapter 5, Problem 14(a) only.

[7] Special problem: On the next page is shown a theoretical electronic band structure calculation for aluminum, together with the corresponding density of states. The energy is in Rydbergs = Ry = 13.605 eV. The electronic configuration of atomic aluminum is $1s^2 2s^2 2p^6 3s^2 3p^1$. It is fcc with lattice constant 4.05 Å.

- **(a) Which are the core electrons and which are the valence electrons in aluminum?**
- **(b) Show, by numerical check at five equally spaced points, that the band extending from Γ to X actually is very close to that expected for a totally free electron (what your text calls the empty lattice model). Note that you will need to use the correct magnitude for the wave vector along this direction.**
- **(c) Show, also by numerical check at five points, that the calculated density of states curve follows on average that expected for a free electron.**
- **(d) Do an approximate numerical integration of the density of states (given in states/eV) from the bottom of the bands to the Fermi level, and show that it yields an answer consistent with the number of valence electrons.**
- **(e) What is the group velocity of an electron in a state just beyond L and going toward W?**
- **(f) Bragg reflection from which set of planes is responsible for the gap at X?**
- **(g) Qualitatively explain the little peaks and valleys in the density of states centered on the dashed lines.**

ALUMINUM – ELECTRONIC BANDS + D.O.S.