I. PROBLEM SESSION 1

A. Problem 1

Consider first the simple cubic (sc) lattice (see figure 8 in Kittel). Write down the primitive vectors of this lattice. Next write down the basis vectors of the conventional unit cell of the face centered cubic (fcc) lattice. Then try to find the a primitive cell for this lattice and write down its unit vectors. Remember that the primitive cell only contain a single atom.

Barium Titanate, $BaTiO_3$,(that has a so-called cubic perovskite lattice structure)where the Ba atom sits in the corner of a cube, the O atoms are face centered on the sides of the cube, and the Ti atom is space centered in the cube.

-Find the primitive and basis vectors.(hint remember that each element constitutes its own sublattice)

-Find the Bravais lattice (primitive lattice) describing $BaTiO_3$.

B. Problem 2

Indices of planes:

-For the simple cubic lattice, make a scetch where you draw the planes (010), $(20\bar{1})$ and $(1\bar{2}1)$. Consider next the planes with indices (100) and (001) of the fcc lattice, anwhere the indices refer to the conventional cubic unit cell. What are the indices of these planes when referred to the axis of the fcc primitive cell (these are illustrated in Fig.11(see Kittel page 11))?

C. Problem 3

The coverage of a lattice structure is the maximum fraction of space filled by non-overlapping spheres centered on the sites of the lattice. Show that the coverage of a simple cubic lattice is 52%, a body-centered cubic lattice (bcc) has the coverage of 68%, and a facecentered cubic lattice (fcc) has the coverage of 74%. (hint: consider spheres of equal size at each lattice point)