In the name of the Greatest

Advanced Solid States – Series 1 **Deadline: Monday November 3**

Problem 1-1) Consider a crystal with the following lattice vectors: $a_1 = 2\hat{x}$, $a_2 = \hat{x} + 3\hat{y}$

Sketch the primitive crystal structure and the reciprocal lattice.

Distinguish the first Brillouin zone.

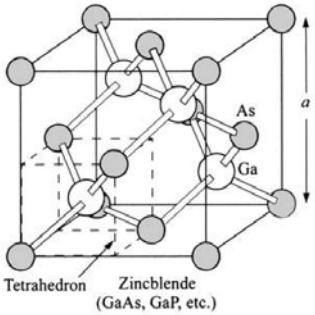
Problem 1-2) A Trigonal lattice has a lattice constant of 3 Angstroms with the angle of 45 degrees.

a) Draw the primitive and the reciprocal lattice.
b) Draw equivalent <100>, <110> and <111> directions in the lattice.
c) Could we name the lattice in any other type of 3D shapes?
d) Describe and sketch the first Brillouin zone.

Problem 1-3) Gallium-Arsenide crystal structure has a Zinc-Blend unit cell:

Assume that the lattice constant of the unit cell is 5.5 Angstroms and the mass numbers of Gallium and Arsenic are 70 and 75 respectively;

Calculate the volume and mass densities.



Problem 1-4) Calculate the areal density of Si atoms on the planes: <100>, <110> and <111>, considering the lattice constant is 5.4 Angstroms. Calculate the distance between two adjacent <111> planes passing through nearest neighbor atoms.

☼) Show that if a single layer of a conductive atom is deposited on the surface of the plane <111> of the Si in the Si crystal, it forms a 2D structure very similar to a single layer Graphene sheet.

Problem 1-5) Explain and find the volume density of a BCC structure in comparison to the simple cubic structure with the same lattice constant.