AML 120: Materials Science

ate: 06/02/14, **Time:** 05:30-06:30 AM (1 h) **Minor Exam 1**
ax. Marks: 60

1. Determine the entropy of mixing equal numbers of two different kinds of atoms on one mole of mixed atomic sites ($R = 8.314$ J mol^{-1}K^{-1}).

[10]

2. i) What is the defining symmetry for the following lattices?
   a) Cubic
   b) Tetragonal
   c) Triclinic

[3]

   ii) Determine the Miller indices of a plane that makes an intercept of 2Å, 3Å and 4Å on the coordinate axes of an orthorhombic crystal with a:b:c = 4:3:2. [7]

3. For an unknown cubic metal the Bragg angles, θ, obtained with CuK_α radiation (λ = 1.541 Å) are: 20.1°, 29.2°, 36.6°, 43.5°, 50.2°, 57.4°, 65.5°.
   (a) Find the indices of all peaks.
   (b) Determine the lattice constant "a" for this metal. [10]

4. In the ionic compound AB, radius of A^+ = 1.65 Å and B^- = 1.81 Å. (a) determine the ligancy (coordination number), (b) assuming the class of the ionic crystal to be cubic, give the crystal structure (space lattice, basis), (c) calculate the packing efficiency of the crystal. [2+3+5]

5. (a) In a unit cell of cubic diamond crystal, show in a plan view (x-y plane) the location of carbon atoms sitting in the tetrahedral void positions and give their coordinates (x,y,z). [4]
   (b) For a BCC iron, give the locations of octahedral voids. Derive the maximum size (radius) of the sphere with respect to the radius of the iron atom which could be fitted in the void without causing distortion. [6]

6. (a) Give the factors which promote non-crystallinity in polymers. [4]
   (b) Estimate the weight fraction of sulphur in a specimen of polyisoprene rubber having 2% of the mers cross linked. Atomic masses of H, C and S are 1, 12 and 32 amu respectively. [6]