EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2002/2003

SECOND SEMESTER

(MARCH/APRIL 2004)

PH 304 CONDENSED STATE PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. (a) Define the terms *lattice, basis, conventional unit cell* of a crystal structure. What do you understand by Miller indices (hkl) of a crystal plane? Show that the spacing between consecutive parallel planes of Miller indices (hkl) in a cubic crystal of lattice constant a is given by

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

(b) What do you understand by *packing fraction* of a crystal structure? Crystal structure of a metal is *fcc*. The spacing d_{100} between adjacent (100) planes of the crystal is $2A^0$. Calculate

(i) radius of the atoms in the crystal

(ii) packing fraction of the crystal structure.

What are the assumptions you have made in these calculations?

2. (a) If the Aluminium lattice is *fcc* and the nearest neighbor distance between Aluminium atoms is $2.86A^0$. find

(i) The lattice constant

(ii) The spacing between (111) planes.

(iii) The number of atoms per unit volume

(iv) The density of Aluminium

You may assume that atomic mass of Aluminium is $26.78g$ and the Avogadro's number is $6.023 \times 10^{23} mole^{-1}$.

(b) Briefly describe the Bragg's diffraction in crystals and show that the Bragg condition for crystal diffraction on (hkl) planes is

$$2d_{hkl} sin\theta_{hkl} = n\lambda$$

The symbols have their usual meanings.
$K_\alpha - X$ Rays from a target are incident on a cubic crystal of lattice constant $4.06A^0$ and the diffracted beam from (111) planes is observed at a Bragg angle 8.7^0. Assuming order of diffraction $n = 1$ determine the wave length of $K_\alpha - X$ Ray.