EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2009/2010

SECOND SEMESTER (Special Repeat)

(February/March 2013)
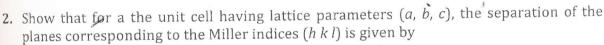
PH 304 CONDESED STATE PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. Give a sketch of hexagonal close-packed (h.c.p) structure and show that the c/a ratio of the unit cell dimensions of an h.c.p lattice is $\sqrt{8/3}$.

   Identify the *Bravias lattice* and the *basis* that generate the h.c.p crystal structure.

   Zinc has an *hcp* structure with lattice parameter $a=2.66$ Å. If the atomic mass of zinc is 65.37 a.m.u., find the packing fraction and density of zinc. (1 a.m.u.=1.66 x 10^{-27} kg).

   Draw the atomic plane represented by Miller indices (1 1 0) in zinc lattice and find the atomic planar density (number of atoms per unit area) of this plane.

2. Show that for a the unit cell having lattice parameters (a, b, c), the separation of the planes corresponding to the Miller indices $(h\,k\,l)$ is given by

$$d_{hkl} = \left[\left(\frac{h}{a}\right)^2 + \left(\frac{k}{b}\right)^2 + \left(\frac{l}{c}\right)^2 \right]^{-\frac{1}{2}}.$$

   Briefly explain the Laue Method used for crystallographic studies.

   A transmission Laue photograph is taken of an orthorhombic crystal whose unit cell has dimensions $a=3.5$ Å, $b=3.0$ Å and $c=2.5$ Å. The single crystal is oriented so that the x-axis is parallel to the horizontal incident x-ray beam with positive direction towards the x-ray source, the y-axis is perpendicular to the incident beam and parallel to the film and the z-axis is vertically downwards. If the film is 5 cm beyond the crystal then find where the (1 0 2) plane's reflection strikes the film and the wavelength of the x-ray reflected by (1 0 2) plane.

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