EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2005/2006 (AUG-SEP. 2007)

FIRST SEMESTER

REPEAT

PH 304 – CONDENSED STATE PHYSICS

Time: 01 hour.
Answer ALL Questions.

1.(a) Define the terms *lattice, basis,* and *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. Describe an experimental method for the determination of the crystal structure of powdered sample.

State the Laue condition for the constructive interference of X – rays diffracted by a crystal.

Show that the Laue condition is equivalent to the Bragg condition $n\lambda = 2d\sin\theta$. Here the symbols have their usual meaning.

The wavelength of a prominent X – ray line for a Cu target is known to be $1.537A^0$. This radiation incident upon an Al crystal produces a diffracted beam off the (111) planes at the Bragg angle 19.2^0. Al is fcc with a density of $1.908 g/cm^3$ and has a atomic weight 26.98. From these data calculate the Avogadro's number.