NATIONAL OPEN UNIVERSITY OF NIGERIA
14/16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
MARCH/APRIL 2014 EXAMINATION

COURSE CODE: PHY 307
COURSE TITLE: SOLID STATE PHYSICS I
TIME ALLOWED: 2 1/2HOURS
INSTRUCTION:ANSWER QUESTION ANY FIVE QUESTIONS

Physical constants: m_e = 9.1x 10^{-31} Kg; q = 1.602 x 10-19 C, h = 6.626 x 10^{-34}J.S

QUESTIONS ONE

a. Explain the following terms
   i. Inter atomic force
   ii. Vander Waals (Molecular) bonding
   iii. Ionic bonding
   iv. Covalent bonding

b. If x, y and z axes intercept 3, 4, and 2, calculate the Miller indices

QUESTIONS TWO

a. Define the term packing fraction, f, as in relates to the closeness of packing in a crystal structure.

b. State the three simple cubic latticeshave basis vectors.

c. State the Cauchy relation in a crystal of cubic symmetry.

d. The conditions for the validity of the Cauchy relations.

QUESTIONS THREE

a. State Bragg's law of diffraction.

b.
   i. What is a crystal?
   ii. What is a lattice?

c. Explain in tabular form the seven crystal systems in terms of unit cell and number of lattice

QUESTIONS FOUR

Briefly describe the mechanism of thermal conductivity for crystalline insulating solids. The thermal conductivity of a solid electrical insulator can be written as:

$$k = \frac{1}{3} cvl$$

where c is the heat capacity per unit volume , v the velocity , and l the mean free path. Provide estimates of these parameters with physical justifications for a typical crystal at room temperature.

QUESTIONS FIVE

a. State the general principles of determining the Miller Indices.

b.

i. What is superconductivity?
ii. What do you understand by acoustic attenuation.
iii. What do you understand by primitive and non-primitive cell?
iv. Succinctly describe a Bravais lattices.

QUESTIONS SIX

a. Describe in details the Hall Effect.

b. At room temperature, $k_B \frac{T}{e} = 26 mV$. A sample of cadmium sulfide displays a mobile carrier density of $10^{16} cm^{-3}$ and a mobility coefficient $\mu = 10^2 cm^2/volt\ sec$.

i. Calculate the electrical conductivity of this sample
ii. If the charge carriers have an effective mass equal to 0.1 times the mass of a free electron, what is the average time between successive scattering.

QUESTION SEVEN

A beam of electrons with kinetic energy of 1.0 eV is diffracted as it passes through a polycrystalline metal foil. The metal has a cubic crystal structure with a spacing of 1Angstroms.

a. Calculate the wavelength of the electrons
b. Calculate the Bragg angle for the first order diffraction maximum.