NATIONAL OPEN UNIVERSITY OF NIGERIA
14/16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
JUNE/JULY EXAMINATION
COURSE CODE: PHY407
COURSE TITLE: Solid State Physics II
TIME ALLOWED:3 Hours
INSTRUCTION: Answer any five questions.

PHYSICAL CONSTANTS:

Speed of light $c = 2.9979 ms^{-1}$; mass of electro $m_e = 0.9110 \times 10^{-31} kg$;
Electronic charge $e = 1.6022 \times 10^{-19} C$; Avogadro's number
$N_A = 6.0221 \times 10^{26} kmol^{-1}$; Boltzmann constant $k = 1.3806 \times 10^{-23} J K^{-1}$;
Plank's constant $h = 6.6257 \times 10^{-34} Js$; $\mu_0 = 4\pi \times 10^{-7} Henry/m$.

1. (a) (i)Write down the equation for the field of an electric dipole**4 marks**
(b) Two water molecules each having dipole moment 6.2×10^{-30}Cm point in the same direction along the line joining the centres. Calculate the electric field due to dipole-dipole interaction when the centres are $3.1 \times 10^{-10} m$ apart. **10 marks**

2. (a) what do you understand by polarization in dielectrics
6 marks
(b) Obtain the Clausius-Mossotti formula relating microscopic dielectric constant with macroscopic polarization. **8 marks**

3. (a) What do you understand by depolarization field?**4 marks**

(b) Obtain the relation among polarization $\vec{P}$ in solid dielectric the electric field $\vec{E}$ and electric flux density or the electric displacement vector $\vec{D}$.**10 marks**

4. (a)What do you understand by dipole *relaxation time*?**4 marks**
(b) Find the frequency dependence of the electronic polarizability of an electron having the resonance frequency ω_o, treating the system as a simple harmonic oscillator.**10 marks**

5. (a)Briefly explain what is meant by*paramagnetism*. Give two examples of paramagnetic material.**4 marks**
(b) Obtain the Langevin function and define all the symbols used in it.**10 marks**

6. (a) What are *ferromagnetic materials?*Give two examples of

Ferromagnetic materials.**4 marks**
(b)Derive the relation of Curie-Weiss law.**10 marks**

7. (a) Mention four of the major defects in crystals.**4 marks**
(b) Write short notes on
(i) Twin boundaries**5 marks**
(ii) Interstcialcy.**5 marks**