



**Arab Academy for Science & Technology
and Maritime Transport – Cairo Branch
College of Engineering & technology
Electronics & Communication Engineering Department**



EC311 – Electronic Materials

Problem Set No.4: Dielectrics II

Duration: Week# 4

Avogadro's number (N_A) = 6.02×10^{23} atoms/mol

$\epsilon_0 = 8.85 \times 10^{-12}$ F/m

P1) An electric field is applied on a material having an FCC crystal structure and an atomic number of 29 and lattice constant of 3.6 \AA . The average displacement of electrons relative to the nucleus is $1 \times 10^{-8} \text{ \AA}$. Calculate the polarization.

P2) Consider air, which is composed of N_2 and O_2 . The dielectric constant of air is 1.00059 at standard temp and pressure (STP). The number of molecules per cubic meter in air is equal to $2.7 \times 10^{25} \text{ m}^{-3}$. Find the polarization and the polarizability if $E = 2 \text{ V/m}$.

P3) For a Hydrogen atom in an external electric field normal to the plane of the orbit, show that $\alpha = 4\pi\epsilon_0 a_H^3$ where a_H is the radius of the unperturbed orbit.

P4) Prove that when a molecule is polarized by a field, a potential energy is stored in the molecule, the value is $\frac{1}{2} \alpha E^2$ (α is the polarizability) find the energy for an atom in a field 10^3 v/m , if $\alpha = 1.47 \times 10^{-40} \text{ F m}^2$