Module 2 Unit 2

DIELECTRICS – NUMERICAL PROBLEMS

- Avogadro's number $N_0 = 6.023 \times 10^{23}$/mol
- Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

1. Consider a parallel plate capacitor of area 5 cm^2 having 1 mm gap between the plates. If the plates are charged to 10^{-10} C, calculate the resulting voltage when there is no medium between them and when there is a medium of dielectric constant 7.
2. Two capacitors having same area of plates are made by using films of glass having thickness 500 micron and plastic of thickness 250 micron. Dielectric constant of glass is 5.8 and that of plastic is 3.2. Which capacitor would hold greater charge if they are subjected to the same voltage?
3. A parallel plate capacitor is made of plates of area 0.25 cm^2 separated by a material of dielectric constant 2.8 and thickness 5 mm. If the plates are applied with a potential difference of 100 volt, calculate charge, electric field, electric displacement and polarization produced.
4. Calculate polarization and electric displacement if a medium of dielectric constant 4.7 is subjected to electric field of 1000 V/m.
5. Consider a crystal subjected to electric field of intensity 1000 V/m. If induced polarization is 4.5×10^{-8} C/m^2, calculate relative permittivity and dielectric susceptibility of the crystal.
6. The concentration of hydrogen gas at NTP is $9.8 \times 10^{26}/m^3$. Calculate electronic polarizability and dielectric constant. Assume radius of atom to be 0.53 Å.
7. Calculate electronic polarizability of argon. Its dielectric constant is 1.00043 and atomic density is $2.7 \times 10^{25}/m^3$.
8. The dielectric constant for helium is 1.000074. Calculate the dipole moment per atom when the gas is subjected to electric field of intensity 8×10^4 V/m. Atomic density is $2.7 \times 10^{25}/m^3$.
9. Dielectric constant of a material is 2.87 and its atomic density is $3 \times 10^{28}/m^3$. Calculate its electronic polarizability using Clausis-Mossotti equation. Also, calculate atomic dipole moment and total polarization produced. Electric field applied is 5000 V/m.
10. Dielectric constant of neon is 1.000134. Calculate electronic polarizability of neon if radius of neon atom is 0.735 Å. Hence, calculate density of neon gas if its atomic weight is 20.
