



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



EC311 – Electronic Materials

Problem Set No.3: Dielectrics I

Duration: Week# 3

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

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

P1) The static dielectric constant of water is 81. Assuming the electric field intensity, E , in water is 1 V/m, determine the magnitude of the electric flux density (electric displacement), D and electric polarization vector, P within the water.

P2) Two metal plates of area 10 cm^2 are placed 5 mm apart. A dielectric with $\epsilon_r=2.5$ and thickness 3 mm, is placed mid-way between the plates. A potential of 100 V is applied across the plates. Determine:

- i- the capacitance of the arrangement,
- ii- the free surface charge density,
- iii- the flux density in all regions,
- iv- the electric field in all regions,
- v- the bound (polarized) charge density.

P3) A potential difference of 15 KV is applied across the terminals of a capacitor consisting of two circular plates, each having an area of 200 cm^2 separated by 1 mm of the dielectric. The capacitance is $4.5 \times 10^{-4} \mu\text{F}$. Calculate the followings:

- i - The charge density
- ii - The electric field
- iii - The dielectric constant of the dielectric

P4) Explain with sketches the steps you may use in the lab to measure the dielectric constant, ϵ_r , of a dielectric slab of thickness L and area A . You have 2 metal palates each of area A , a battery, a voltmeter, a switch and some wires.

P5) Put (T) for right statements and (X) for wrong ones. Correct the wrong ones:

- (a) The local field in a dielectric sample is a microscopic quantity while the Maxwell's field is a macroscopic field that fluctuates within the medium. ()
- (b) The capacitance is the charge storing ability per unit volume. ()
- (c) The units of the dielectric constant, ϵ_r , is Farad/ m^2 . ()