EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE 2004/05 (OCT/NOV. 2006) (REPEAT)

SECOND SEMESTER

PH 207 ELECTRICITY AND MAGNETISM - II

Answer ALL Questions. Time: 01 hour.

---

01. A dielectric slab of thickness a and dielectric constant K is placed symmetrically between the plates of a parallel plate capacitor of area A and a separation b. Show that the capacitance of the capacitor is

$$C = \frac{K\varepsilon_0 A}{K(b-a)},$$

where ε_0 is the permittivity of free space.

A parallel plate capacitor has plates area 0.12 m^2 and a separation of 1.2 cm. A battery charges the capacitor to a potential difference of 120 V and is then disconnected. A dielectric slab of thickness 4.0 mm and dielectric constant 4.8 is then placed symmetrically between the plates. Determine

(i) Capacitance of the capacitor before and after the slab is inserted

(ii) The Electric field in the space between the plates and in the dielectric

(iii) The Potential difference across the plates with the slab in place

(iv) The Displacement vector D and the Polarization vector P in the dielectric.

Assume $\varepsilon_0 = 9.0\times10^{-12} Fm^{-1}$.

02. Write down Maxwell's equation in free space with permittivity ε_0 and permeability μ_0.

Starting from Maxwell's equation obtain the wave equation for Electric field in free space and show that the velocity of the Electromagnetic wave is given by

$$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}.$$

r an Electromagnetic wave in free space of the form

$$E(z,t) = E_0 e^{i(\omega t - Kz)}$$

$$B(z,t) = B_0 e^{i(\omega t - Kz)}$$

(i) Find the relation between K and ω

(ii) Find the relation between E_0 and B_0.

You may assume the following vector equation

$$\vec{\nabla} \times \vec{\nabla} \times \vec{A} = \vec{\nabla}.(\vec{\nabla}.\vec{A}) - \nabla^2 \vec{A},$$

The symbols have their usual meanings.