題號： 259
科目：電磁學(B)
節次： 4

國立臺灣大學 103 學年度碩士班招生考試試題

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1.(20%) Using Gauss' law, find the absolute value of the magnetic flux crossing that portion of the surface $y=\sin x$ bounded by $x=0$, $x=\pi$, $z=0$, and $z=1$ for the magnetic field given by

$$\vec{B} = B_0(y\vec{a}_x - x\vec{a}_y) \quad \text{Wb/m}^2$$

2. (20%) Consider charge distributed with uniform density ρ_0 C/m³ in the region $a<r<2a$ in spherical coordinates. Find the electric displacement $\vec{D}$ everywhere.

3.(18%) The electric field of a uniform plane wave in free space is given by

$$\vec{E} = E_0 \cos(\omega t - \beta z)\vec{a}_x - E_0 \sin(\omega t - \beta z)\vec{a}_y \quad \text{V/m}$$

(a) Determine the polarization of the wave.
(b) Find the associated magnetic field $\vec{H}$.
(c) Find the instantaneous Poynting vector.

4.(18%) For a uniform plane wave propagating in the +z-direction in a material medium with $\sigma=0$, $\varepsilon=9\varepsilon_0$, $\mu=\mu_0$, the magnetic field intensity in the z=0 plane is given by

$$\vec{H}\Big|_{z=0} = \cos^3(2\pi \times 10^8 t)\vec{a}_y \quad \text{A/m}$$

(a) Find the phase velocity of the wave.
(b) Find the impedance of the medium for the field.
(c) Find the associated electric field $\vec{E}(z;t)$.

5. (24%)
(a) (8%) State Gauss' laws in differential and integral forms.
(b) (5%) What is the relationship between the frequency and phase velocity of an electromagnetic wave in a material medium?
(c) (5%) State the divergence theorem.
(d) (6%) What is the consequence of a wave incident on a perfect conductor?

試題隨卷繳回