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科目： 電磁學(B)
節次： 4

國立臺灣大學 106 學年度碩士班招生考試試題

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1. (15%) Consider the volume charge distributed uniformly with density ρ_0 C/m³ between the planes $z = -a$ and $z = a$. Find the electric field $\vec{E}$ everywhere.

2. (15%) Current flows with density $\vec{J} = J_0(r/a)\vec{a}_z$ A/m² along an infinitely long solid cylindrical wire of radius a having the z-axis. Find the magnetic field $\vec{H}$ everywhere.

3. (25%) The magnetic field of a uniform plane wave propagating in free space is given by

$$\vec{H} = \cos(3\times10^8 t - z)\vec{a}_y \quad \text{A/m}$$

(a) Find the direction of propagation of the wave. (5%)
(b) Find the associated electric field $\vec{E}$. (5%)
(c) Find the instantaneous power flow across a surface of area 1m² in the z=0 plane at $t = 10^{-8}$ s. (5%)
(d) Find the time average power flow across a surface of area 1m² in the z=0 plane. (10%)

4. (25%) The electric field of a uniform plane wave propagating in a perfect dielectric medium having $\mu = \mu_0$ is given by

$$\vec{E} = \cos(4\times10^7 t + 0.2x)\vec{a}_z \quad \text{V/m}$$

(a) Find the frequency. (5%)
(b) Find the wavelength. (5%)
(c) Find the phase velocity. (5%)
(d) Find the permittivity of the medium. (5%)
(e) Find the associated magnetic field $\vec{H}$. (5%)

5. (20%) An infinite plane sheet in the $z = 0$ plane carries a surface current of density

$$\vec{J}_s = -\cos(2\pi\times10^6 t)\vec{a}_x \quad \text{A/m}$$

The dedium on either side of the sheet is characterized by σ=1 S/m, $\varepsilon = 4\varepsilon_0$, $\mu = \mu_0$. Find $\vec{E}$ and $\vec{H}$ on either side of the current sheet.

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