國立臺灣大學 104 學年度碩士班招生考試試題

1.(20%) Consider current distribution with uniform density $J_0\vec{a}_z$ A/m^2 in the volume between the planes $y = -a$ and $y = 0$, and with uniform density $-J_0\vec{a}_z$ A/m^2 in the volume between the planes $y = 0$ and $y = a$. Find the magnetic flux density everywhere.

2.(20%) A magnetic field is given in the xz-plane by $\vec{B} = B_0\cos(x - v_0 t)\vec{a}_y$ Wb/m^2. Consider a regid square loop situated in the xz-plane with its vertices at $(x, 0, 1)$, $(x, 0, 2)$, $(x+1, 0, 2)$, and $(x+1, 0, 1)$.

(a) Find the emf induced around the loop in the sense defined by connecting the above points in succession.

(b) What would be the induced emf if the loop is moving with the velocity $\vec{v} = v_0\vec{a}_z$ m/s instead of being stationary?

3.(20%) The current densities of two infinite, plane, parallel current sheets in free space are given by

$\vec{J}_1 = -J_0\cos\omega t\vec{a}_x$ in the $z = 0$ plane

$\vec{J}_2 = -aJ_0\cos\omega t\vec{a}_x$ in the $z = \lambda/2$ plane

Find the electric field intensities and magnetic field intensities everywhere.

4. (20%) A current distribution is given in cylindrical coordinates by

$$\vec{J} = \begin{cases} J_0\vec{a}_z & for \quad r < a \\ -J_0\vec{a}_z & for \quad 2a < r < 3a \end{cases}$$

Find the energy stored in the magnetic field of the current distribution per unit length in the z-direction.

5.(20%) Region 1 ($z < 0$) is a perfect dielectric, whereas region 2 ($z > 0$) is a perfect conductor. For a uniform plane wave having the electric and magnetic fields

$\vec{E} = E_0\cos(\omega t - \beta z)\vec{a}_x$

$\vec{H} = (E_0/\eta)\cos(\omega t - \beta z)\vec{a}_y$

is normal incident on the interface from region 1.

(a) Find electric and magnetic fields of the reflected wave.

(b) Find the total electric and magnetic fields in the dielectric region.

(c) Find the current density on the surface of the perfect conductor.

試題隨卷繳回