

題號： 364
 科目： 電磁學(C)
 節次： 7

國立臺灣大學 111 學年度碩士班招生考試試題

題號： 364

共 1 頁之第 1 頁

※ 請於答案卷上非選擇題作答區標明題號作答。計算題請詳列過程。 $\epsilon_0 = 10^{-9}/(36\pi)$ [F/m], $\mu_0 = 4\pi \times 10^{-7}$ [H/m]

1. (計算題 40%) Consider a finite-width parallel-plate transmission line formed by two perfectly conducting plates of width w separated by a spacing d . A perfect dielectric ($\mu_r = 1, \epsilon_r > 1$) filled in between them. Assume that the fringing fields can be neglected and the transverse electromagnetic waves propagate along the z -axis are given by $\mathbf{E} = (V_0/d) \cos(4\pi \times 10^9 t - 30\pi z) \mathbf{a}_x$ [V/m] and $\mathbf{H} = (I_0/w) \cos(4\pi \times 10^9 t - 30\pi z) \mathbf{a}_y$ [A/m], where V_0, I_0, d , and w are constants.
- (4%) What is the frequency f of the electromagnetic waves in the parallel-plate transmission line?
 - (4%) What is the phase velocity v_p of the electromagnetic waves in the parallel-plate transmission line?
 - (4%) According to (b), what is the relative permittivity ϵ_r of the dielectric filled in between the two conducting plates?
 - (4%) Based on (c), what is the capacitance per unit length C of the parallel-plate transmission line for static fields?
 - (4%) Based on (d), what is the characteristic impedance Z_0 of the parallel-plate transmission line?
 - (4%) Based on (e), if one end of the parallel plate transmission line is short-circuited, what is the voltage reflection coefficient Γ ?
 - (4%) Based on (e), if the parallel plate transmission line is terminated with a resistive load without reflection, what is the load resistance R_L ?
 - (4%) Please find the instantaneous Poynting vector \mathbf{P} associated with the electromagnetic waves.
 - (4%) Please find the time-average Poynting vector $\langle \mathbf{P} \rangle$ associated with the electromagnetic waves.
 - (4%) Please find the time-average power flow $\oint \langle \mathbf{P} \rangle \cdot d\mathbf{s}$ along the parallel-plate transmission line.

2. (計算題 10%) A quarter-wave transformer (QWT) is used to match the impedance of a load as shown in Fig. Q2.
- (5%) Please derive d_q for complete matching.
 - (5%) Please derive Z_q for complete matching.

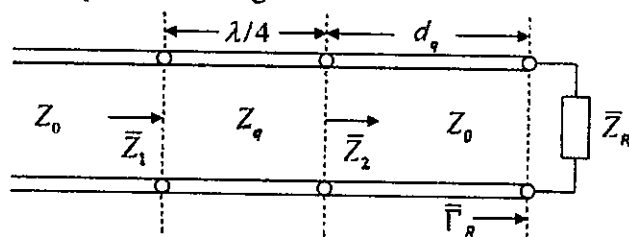


Figure Q2

3. (計算題 20%) A plane wave of 1.5 GHz propagates along the z -direction in an anisotropic dielectric. It is linearly polarized at the beginning of propagation. The x - and y -components of its electric field are equal in magnitude. If the permittivity tensor of the anisotropic dielectric is

$$\epsilon = \epsilon_0 \begin{bmatrix} 4.41 & 0 & 0 \\ 0 & 4.00 & 0 \\ 0 & 0 & 3.24 \end{bmatrix}$$

- (10%) Please find the phase difference between its x - and y -components after it propagates a distance L .
 - (6%) Please find the minimum L (in meters) that it becomes circularly polarized.
 - (4%) Please find the minimum L (in meters) that it is still linearly polarized but its polarization rotates 90 degrees.
4. (計算題 30%) An infinitesimal Hertzian-dipole antenna is located at $(0, 0, \lambda/4)$, where λ is the operation wavelength in free space. An infinite perfect conductor surface covers the x - y plane (i.e. $z=0$ plane). The radiation (for $z > 0$) can be equivalent to and simplified as the dipole and its image without the perfect conductor surface.
- (10%) If the dipole current flows along the z -direction, please **find** and **plot** the group pattern due to the dipole and its image on the x - z plane (only $z > 0$).
 - (10%) If the dipole current flows along the x -direction, please **find** and **plot** the group pattern due to the dipole and its image on the x - z plane (only $z > 0$).
 - (10%) Please **find** and **plot** the **total** radiation pattern on the x - z plane (only $z > 0$) in (b).

試題隨卷繳回