國立臺灣科技大學102學年度碩士班招生試題

系所組別： 電子工程系碩士班乙三組

科　　目： 電磁學

（總分為100分）

1. Consider the dielectric slab on top of the perfect conductor shown in Fig. 1. Assume that the magnetic field impinges on the dielectric slab with an angel α. Please calculate the induced current on the perfect conductor. (10 %)

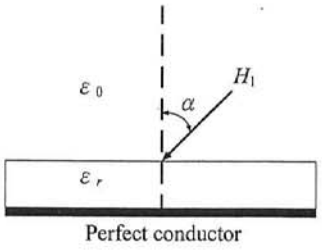

Fig. 1

2. Assuming a charge Q (coulombs) is uniformly distributed on a circular loop having a radius R (meter) as shown in Fig. 2. (a) Please derive the electric potential at point A. (10 %) (b) Please derive the electric field at point A. (10 %)

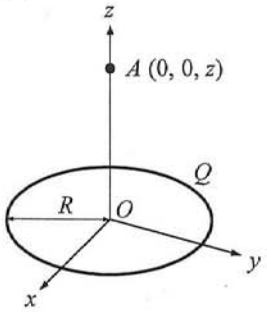

Fig. 2

3. A line current carrying a current I is penetrating out of the paper as shown in Fig. 3. Also, the line current is placed in parallel to two infinite conducting wall at a distance d. (a) Please calculate the magnetic field at point O. (10%) (b) Please calculate the magnetic field at point P. (10%)

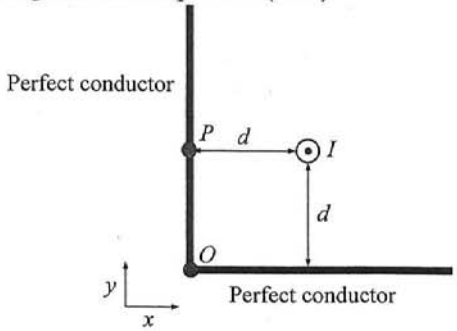

Fig. 3

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4. For the case of oblique incidence of a uniform plane wave with perpendicular polization on a plane boundary with $\varepsilon_1 = \varepsilon_o$, $\varepsilon_2 = 2.25\varepsilon_o$, $\mu_1 = \mu_2 = \mu_o$ (where ε_o and μ_o are permittivity and permeability in vacuum, respectively), as shown in Fig. P4. Assume that f = 500MHz and $\Theta_i = 30^o$
   (a) Find the the propagation constant k_{x1} in the x direction in medium 1, (5%)
   (b) Find the the propagation constant k_{x2} in the x direction in medium 2, (5%)
   (c) Find the electric-field reflection coefficient Γ_r. (5%)

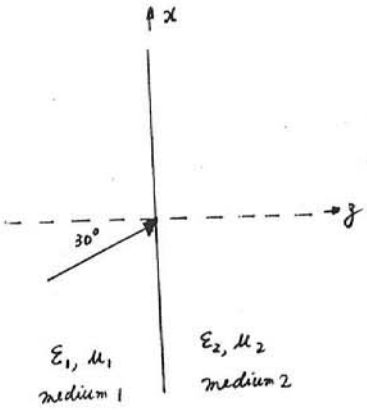

Fig. P4.

5. A harmonic wave is incident from the left onto a junction a-a' with two transmission lines, as shown in Fig. P5. λ is the signal wavelength and Z_i (i=0,1) are the characteristic impedances of transmission lines.
   (a) Find the reflection coefficient of the incident power at the junction a-a' (5%),
   (b) Find the fraction of the incident power dissipated in R_1, (5%)
   (c) Repeat (a) when R_2 is removed and the terminal is left open, (5%)
   (d) Repeat (b) when R_2 is removed and the terminal is left open. (5%)

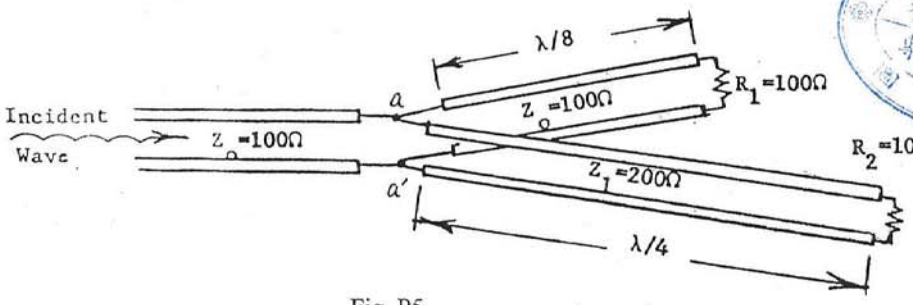

Fig. P5.

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6. Fig. P6 shows a metallic, rectangular, air-filled waveguide with inner dimensions a x b. For Transverse-Electric (TE) waves propagating in the z direction, the electric field E_z vanishes, i.e., $E_z = 0$. The other field components are expressed as follows

$$H_z^o(x,y) = H_o \cos(\frac{m\pi}{a}x)\sin(\frac{n\pi}{b}y)$$

$$E_x^o(x,y) = \frac{j\varpi\mu_o}{h^2}(\frac{n\pi}{b})H_o \cos(\frac{m\pi}{a}x)\cos(\frac{n\pi}{b}y)$$

$$E_y^o(x,y) = -\frac{j\varpi\mu_o}{h^2}(\frac{m\pi}{a})H_o \cos(\frac{m\pi}{a}x)\cos(\frac{n\pi}{b}y)$$

$$H_x^o(x,y) = \frac{j\beta}{h^2}(\frac{m\pi}{a})H_o \cos(\frac{m\pi}{a}x)\cos(\frac{n\pi}{b}y)$$

$$H_y^o(x,y) = \frac{j\beta}{h^2}(\frac{n\pi}{b})H_o \cos(\frac{m\pi}{a}x)\cos(\frac{n\pi}{b}y)$$

where $h^2 = (\frac{m\pi}{a})^2 + (\frac{n\pi}{b})^2$, $\beta = (\varpi^2\mu_o\varepsilon_o - (\frac{m\pi}{a})^2 - (\frac{n\pi}{b})^2)^{1/2}$, ε_o and μ_o are permittivity and permeability in air, respectively. The above five modal expressions are incorrect. Please correct them and put them in the right forms. (15%)

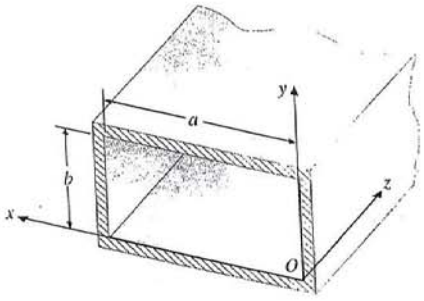

Fig. P6.