

# 國立交通大學 93 學年度碩士班入學考試試題

科目名稱：電磁學(161) 考試日期：93 年 4 月 17 日 第 3 節

系所班別：顯示科技研究所 第 1 頁, 共 2 頁

\*作答前, 請先核對試題、答案卷 (試卷) 與准考證上之所組別與考試科目是否相符!!

1. (20%)

- (a) Write down the time-dependent Maxwell equations in Differential and Integral Form (using  $E, B, H, J, D$ ).
- (b) Derive the continuity equation from the Maxwell equations.
- (c) State Faraday's law and Ampere's Law.

2. (15%) Given six air-filled rectangular waveguides of the following inner dimensions:

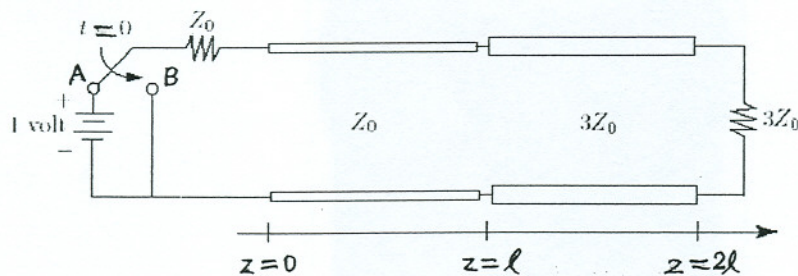
- (a) 40 cm X 40 cm (b) 20 cm X 20 cm (c) 4 cm X 4cm (d) 2cm X 1cm
- (e) 0.4 cm X 0.4 cm (f) 0.2 cm X 0.1 cm

Determine in which waveguides the  $TE_{10}$  mode can propagate and in which waveguides only the  $TE_{10}$  mode can propagate. The frequency  $f = 10\text{GHz}$   
(Hint: find out cutoff frequency)

3. (20%) Using Drawing and formula

- (a) Explain Phase velocity, group velocity (5%)
- (b) State Parallel Polarization and Perpendicular Polarization (5%)  
and write the  $E, H$  expression.
- (c) Explain Brewster angle (5%)
- (d) Explain the Hall effect (5%)

4. (20%) Consider the transmission line circuit below composed of two air-filled transmission lines of different characteristic impedances as shown. The switch has been in position A for  $t < 0$  and at  $t = 0$  switches to position B.



- (a) Sketch the voltage  $V(z)$  on both lines ( $0 < z < 2l$ ) for  $t < 0$ .
- (b) Sketch the voltage  $V(z)$  on both lines ( $0 < z < 2l$ ) for  $t = l/(2v)$ .
- (c) At what time  $t$  will the circuit reach steady-state.

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5. (25%) Two plane waves with wave-vectors  $\vec{k}_1$  and  $\vec{k}_2$  are incident upon a flat surface which separates the space into two regions as shown in Fig 2 below. The upper half space is free space, and the lower half space is a dielectric medium with  $\epsilon = 5\epsilon_0$  and  $\mu = \mu_0$ . The total electrical field in the upper half space (Region 1) is  $\vec{E}_1 + \vec{E}_a$ , and the total electric field in the lower half space (Region 2) is  $\vec{E}_2 + \vec{E}_b$ .

The incident field  $\vec{E}_1$  is given by  $\Rightarrow \vec{E}_1 = \hat{y}E_0 \cos(\frac{k}{\sqrt{2}}(x-z) - \omega t)$

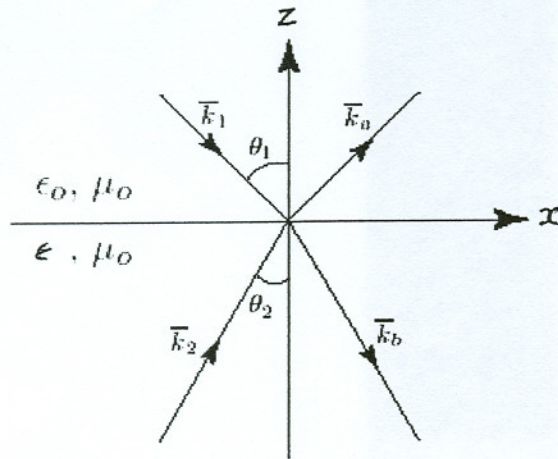


Figure 2

- What is the incident angle  $\theta_1$  for  $\vec{k}_1$ ?
- Find the reflection coefficient  $R_{12}$  of  $\vec{E}_1$ . What is the reflected field of  $\vec{E}_1$ ?
- Let the field  $\vec{E}_a$  be 0, and the incident field  $\vec{E}_2$  be a TE wave. What are  $\vec{E}_2$  and  $\vec{E}_b$ ?
- Let the field  $\vec{E}_a$  be right-handed circularly polarized (r. h. c. p.) and the incident  $\vec{E}_b$  field be a TM wave. Write down the expression for  $\vec{E}_a$ . Find the incident field  $\vec{E}_2$ ?