國立臺北科技大學

九十三學年度電腦通訊與控制研究所入學考試

電磁學試題

填准考證號碼

注意事項：

1. 本試題共 7 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. The static electric field $|\overline{E}_1|$=1 V/m is incident from Teflon (ε_r=2, $\mu_r = 1$) obliquely on vacuum (ε_r=1, $\mu_r = 1$) as shown in Fig. P1. Determine the magnitude of the static electric filed in vacuum. (10 %)

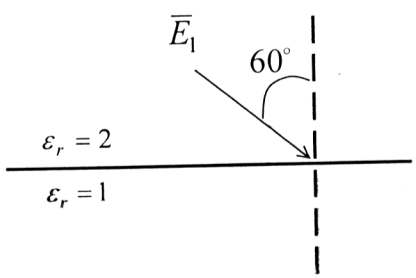

Fig. P1

2. Define (a) intrinsic impedance of a medium (4 %), (b) characteristic impedance of a transmission line (4 %), and (c) input impedance of a circuit (4 %).

3. The time-varying electric and magnetic fields in vacuum are shown below. Find β and η.(10 %)

$$\overline{E}(z,t) = \hat{x}\, E_0 \cos(7.5\times10^6 t - \beta z)$$

$$\overline{H}(z,t) = \hat{y}\, \frac{E_0}{\eta}\cos(7.5\times10^6 t - \beta z)$$

4. For an air-filled TEM transmission line (characteristic impedance 50Ω) with a load as shown in Fig. P4. (a) Find the maximum and minimum input impedances and their minimum locations, when the load is a 20Ω resistance and the frequency is 1 GHz. (15%). (b) Find the minimum length of the transmission line where the input impedance of the loaded transmission line is 100j. The load is a 0.02pF capacitance and the frequency is $\frac{10^{12}}{2\pi}$ Hz.(15%) (Note: using the concept of Smith chart and $\frac{1}{2\pi}\tan^{-1}2 = 0.176$)

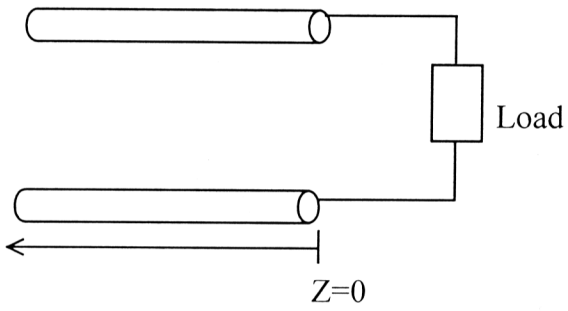

Fig. P4

5. A uniform plane wave with $\overline{E_i}(z) = \hat{x}E_{i0}e^{-j\omega\sqrt{\mu_0\varepsilon_0}z}$ is incident normally from vacuum into a dielectric slab and it results in the reflected field $\overline{E_r}$ and transmitted field $\overline{E_t}$ shown in Fig. P5. Find $\frac{\overline{E_t}(z=d)}{\overline{E_i}(z=0)}$ and $\frac{\overline{E_r}(z=0)}{\overline{E_i}(z=0)}$ in terms of $\Gamma = \frac{\sqrt{\frac{\mu}{\varepsilon}} - \sqrt{\frac{\mu_0}{\varepsilon_0}}}{\sqrt{\frac{\mu}{\varepsilon}} + \sqrt{\frac{\mu_0}{\varepsilon_0}}}$ and $\tau = e^{-j\omega\sqrt{\mu\varepsilon}d}$.(15%)

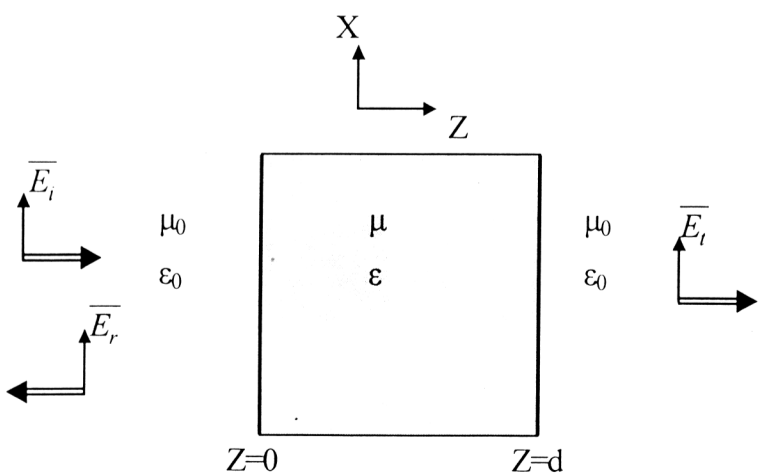

Fig. P5

注意：背面尚有試題

6. A ground plane is covered with polystyrene (ε_r =2.56, $\mu_r = 1$) of thickness $\frac{d}{2}$, where d is much larger than the free-space wavelength λ. Determine the distance (in terms of λ) above the dielectric vacuum interface over which the fields decrease to $\frac{1}{e}$ of their values at the interface. (15%)

7. An array of parallel conducting wires stretched along $\hat{y}$ with separation much smaller than the wavelength as shown in Fig. P7. Suppose that the electric field in the incident electromagnetic wave propagating in $+z$ has both x and y components. Determine the direction of polarization of the transmitted electric field. (8%)

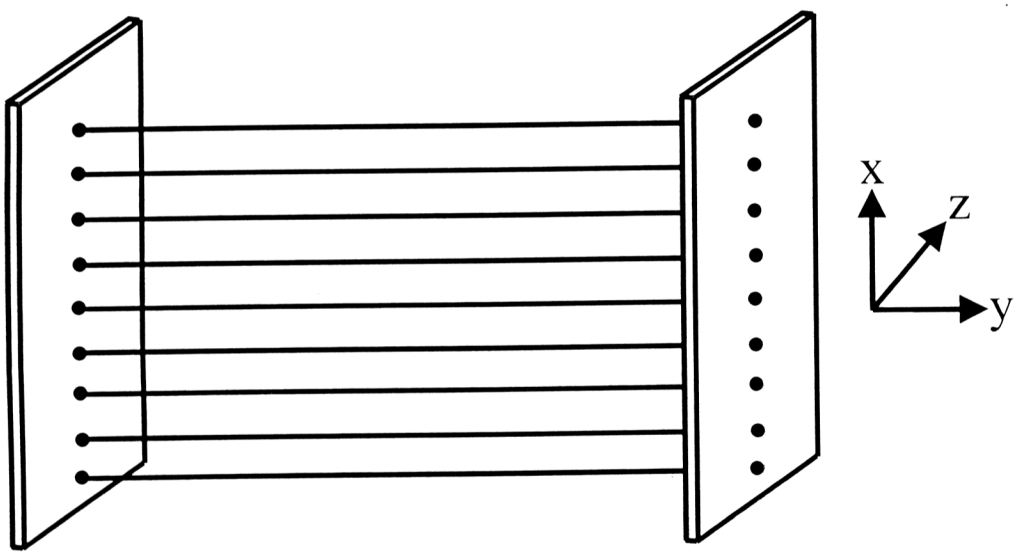

Fig. P7