國立臺灣科技大學

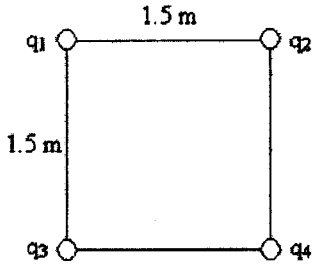
九十四學年度碩士班招生考試試題

系所組別：電子工程系碩士班乙三組、電子工程系碩士班丙組

科　　目：電磁學

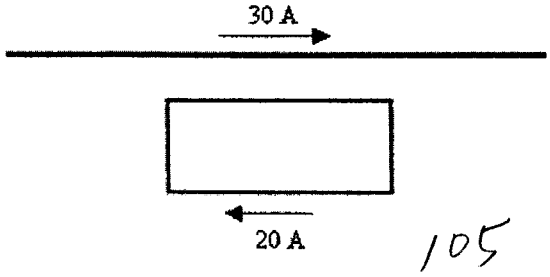
※題分為100分

1) Referring to the figure below, find the electric potential at the center of the square if $q_1 = q_2 = 1.2\times10^{-9}$C and $q_3 = q_4 = -2.0\times10^{-9}$C. (Note $\frac{1}{4\pi\varepsilon_0} = 8.99\times10^9 \text{N}\cdot\text{m}^2/\text{C}^2$)) **(10%)**



2) Find the electric field $\vec{\mathbf{E}}$ at a point located at a distance *a* from the end of a very long, very thin insulating rod that has a uniform charge density of 1 C/m as shown in the diagram. (Hint: You can treat the rod as if it extends infinitely far to the left.) **(10%)**

3) In the figure below, the long straight wire is carrying a current of 30 A, and the rectangular loop is carrying a current of 20 A in the direction shown. The top wire of the rectangular loop is 0.01 m from the long straight wire, while the bottom wire is 0.06 m from the long straight wire. The top and bottom wires of the loop are 1.0 m in length. (a) **(10%)** Calculate the magnetic force on the top wire of the loop. (b) **(10%)** Calculate the magnetic force on the bottom wire of the loop. (c) **(10%)** Calculate the net magnetic force on the loop.



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4. As shown in Fig. p4, a harmonic wave is incident from the left onto a junction with two transmission lines having characteristic impedances Z_o = 100 ohms and Z_1 = 200 ohms. λ in Fig. p4 is the wavelength of the signal. We assume that the incident wave is from the transmission line with the characteristic impedance Z_o = 100 ohms.
   (a) Find the reflection coefficient of the incident wave at the junction a-a′. (10%)
   (b) Find the fraction of the incident power dissipated in R_1 . (5%)
   (c) Repeat (a) when R_2 is removed. (5%)

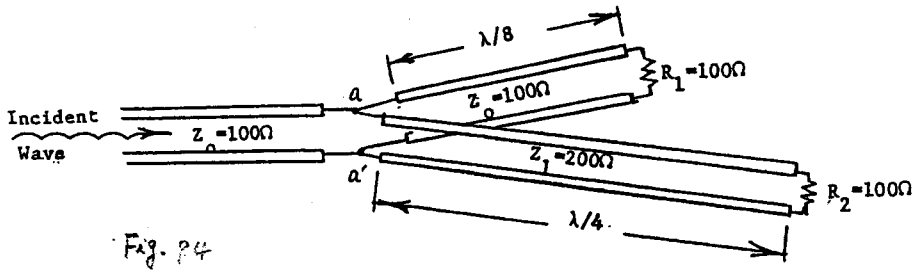

Fig. P4

5. A uniform sinusoidal wave in air with the following phasor expression for the electric field intensity

$$\vec{E}_i(x,y) = \hat{a}_y 5\, e^{-j(12x+16z)} \quad \text{(Volt / Meter)}$$

is incident on a dielectric medium at z=0, as shown in Fig. p5.

   (a) Find the wavelength of the signal. (5%)
   (b) Find the frequency of the signal. (5%)
   (c) Determine the angle of incidence θ_i. (5%)
   (d) Determine the reflection coefficient Γ. (5%)

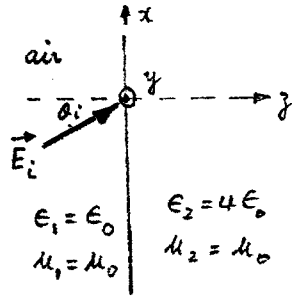

Fig. P5

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6. In Fig. p6, the steady state is established on the lossless transmission line with switch S closed. Z_o is the characteristic impedance of the transmission line. At t = 0, switch S is suddenly open. Sketch the voltage v (z = l, t) for $0 \leqslant t \leqslant 4\,T$ with T = l/u, where u is the propagation velocity of signal. (10%)

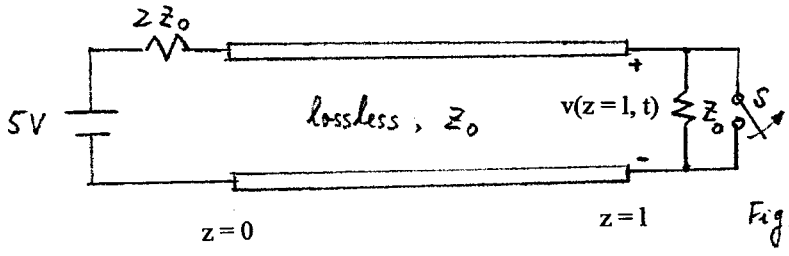

Fig. P6

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