國立台灣科技大學九十八學年度碩士班招生試題

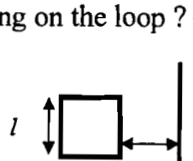
系所組別：電子工程系碩士班乙三組、丙組

科　　目：電磁學

（總分爲 100 分）

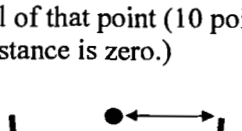
1.(a) Determine the mutual inductance between the conducting rectangular loop and a very long straight wire as shown below (10 points)

(b)Determine the force acting on the loop ? (10 points)



2.(a)Find the electric field at a point located at the center a semicircle wire with a uniform linear charge density ρ and with a radius **a** as shown below .(10 points)

(b)Find the electric potential of that point (10 points) (assuming the potential at infinite distance is zero.)



3. Please write down the divergence $\nabla \cdot$ of a vector field A in spherical coordinate. (10 points)

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4. A uniform sinusoidal plane wave in the air with the phasor expression for electric field intensity as follows

$$\vec{E}_i(x,y,z) = \hat{a}_y 3e^{-j(6x+8z)} \qquad \text{(Volt/meter)}$$

is incident on a dielectric medium at z=0 with the incident angle θ_i=30°, as shown in Fig. 4.

(a) Find the frequency of the plane wave. (5%)
(b) Find the reflection coefficient Γ and transmission coefficient τ. (10%)
(c) Determine the angle of refraction θ_t. (5%)

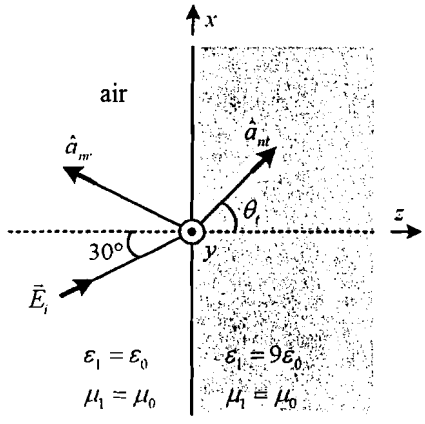

Fig. 4

5. As shown in Fig. 5, a rectangular pulse with a 15 V amplitude and a 1 μs duration is applied through a series resistance of 25 Ω to the input terminal of a 50 Ω lossless coaxial transmission line. This line is 300 m long and is open-circuited at the far end. The dielectric constant (ε_r) of the insulating material in the cable is 4.

(a) Plot the voltage reflection diagram of the transmission line. (10%)
[Hint: A voltage reflection diagram plots the time elapsed after the change of circuit conditions versus the distance z from the source end.]
(b) Determine the voltage response at the midpoint (z = 150 m) of the transmission line as a function of time up to 8 (μs). (10%)

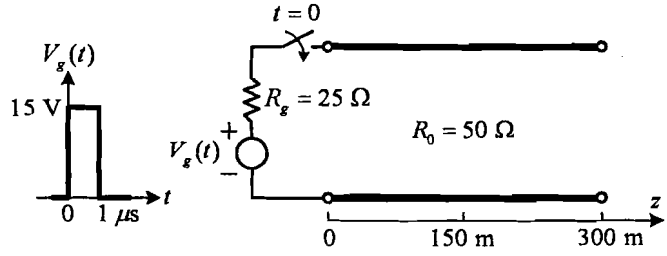

Fig. 5

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6. A TE_{10} wave at 8 GHz propagates in a rectangular waveguide shown in Fig. 6 with inner dimensions a=2 cm and b=1 cm, which is filled with polyethylene ε_r=2.25, μ_r=1. Determine (a) guide wavelength β (5%) and (b) wave impedance Z_{TE10} (5%). [Note: The unit of the guide wavelength β and the wave impedance Z_{TE10} should be indicated.]

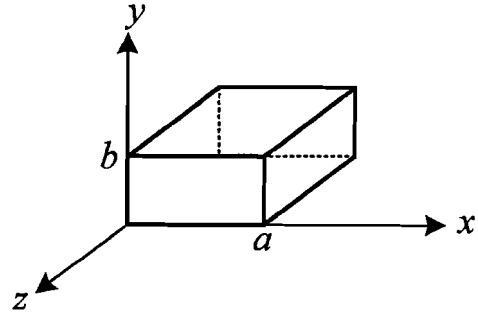

Fig. 6