國立台灣科技大學九十五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100分

1) A coaxial cable has a solid inner conductor of radius a, a thin outer conductor of inner radius b, and a medium with conductivity σ, permeability μ, and permittivity ε. The length of the coaxial cable is Z, Z>>b. (A) Starting from Gauss's law, determine the capacitance C of the coaxial cable (8%). (B) Find the external inductance L of the coaxial cable (6%). (C) Find the leakage resistance between the inner and outer conductors (6%).

2) Explain (A) Faraday's law of electromagnetic induction (6%), (B) the electromagnetic boundary conditions that the field vectors $\vec{D}$(electric flux density) and $\vec{B}$(magnetic field) must satisfy at the interfaces (6%), (C) the dielectric strength of the air and the principle of lightning arrester or lightning rod (避雷器或避雷針) (6%).

3) Two parallel conducting wires carrying currents I_1 and I_2 in opposite directions are separated by a distance D in air. (A) Determine the force per unit length between the wires, if the wires are **infinitely long** (6%). (B) Describe a method to find the force between the wires, if the wires are **not infinitely long** (6%).

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4. The $\vec{E}$-field of a uniform plane wave propagating in a dielectric medium is given by

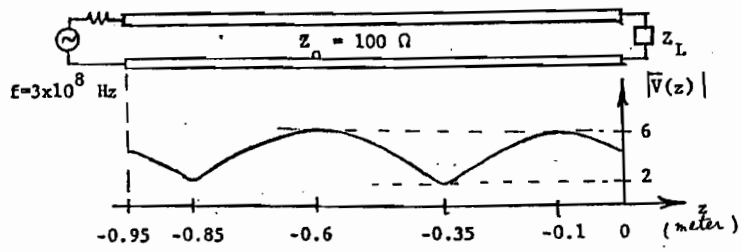
$$\vec{E}(t,z) = \hat{a}_x 2\cos(10^8 t - z/\sqrt{3}) - \hat{a}_y \sin(10^8 t - z/\sqrt{3}) \quad \text{(V/m)}$$

(a) Determine the frequency and wavelength of the wave. (10%)

(b) What is the dielectric constant of the medium ? (5%)

(c) Determine the polarization of the wave. (5%)

5.



The voltage along a transmission line has the magnitude shown above. The frequency is 300MHz. Find

(a) The voltage standing wave ratio VSWR and wavelength. (10%)

(b) The reflection coefficient Γ at the load. (5%)

6. An air-filled a×b (b<a<2b) metallic rectangular waveguide is to be constructed to operate at 4GHz in the dominant mode. We desire the operating frequency to be at least 15% higher than the cutoff frequency of the dominant mode and at lease 15% below the cutoff frequency of the next higher-order mode.

(a) Calculate the dimensions a and b. (8%)

(b) Calculate the guided wavelength λ_g at the operating frequency. (7%)

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