國立臺灣科技大學 107 學年度碩士班招生試題

系所組別：光電工程研究所碩士班

科　　目：電磁學

(總分為 100 分)

1. (15%) A d-c voltage V_0 is applied across a parallel-plate capacitor of area S. The space between the conducting plates is filled with two different lossy dielectrics of thickness d_1 and d_2, permittivity ϵ_1 and ϵ_2, and conductivities σ_1 and σ_2 respectively, as shown in Fig.1. Find
   (a) the current density between the plates. (3%)
   (b) the electric field intensities between the plates. (3%)
   (c) the electric potential $V(x)$ between the plates. (3%)
   (d) the equivalent R-C circuit between terminals a and b. (3%)
   (e) the electric energy stored in two dielectrics separately. (3%)

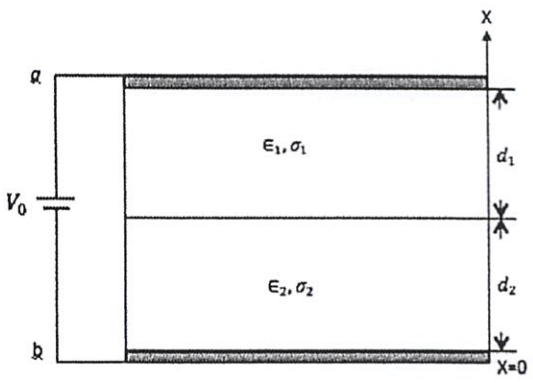

Fig.1.

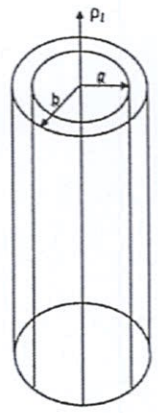

Fig.2.

2. (15%) An infinitely long straight, line charge of a uniform density ρ_l is placed along the central axis (the z-axis) of a cylindrical conducting shell of inner radius a and outer radius b, see Fig.2. Determine
   (a) the electric field intensity $\bar{E}(r)$ as a function of the distance r from the line, everywhere. (7%)
   (b) the electric potential difference between $r < a$ and $r = b$. (8%)

3. (20%) A coaxial transmission line has a solid inner conductor of radius a and a very thin outer conductor of inner radius b and between the conductors a magnetic material with permeability μ is inserted. Assume that a current I flows in the inner conductor and returns via the outer conductor in the other direction. Find
   (a) the magnetic flux density $\bar{B}$ everywhere. (5%)
   (b) the magnetic field intensity $\bar{H}$ everywhere. (5%)
   (c) the magnetization $\bar{M}$ everywhere. (5%)
   (d) the magnetic energy stored between the conductors per unit length of the line. (5%)

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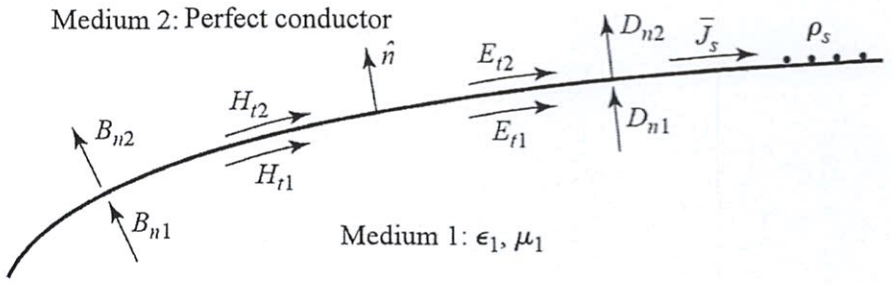
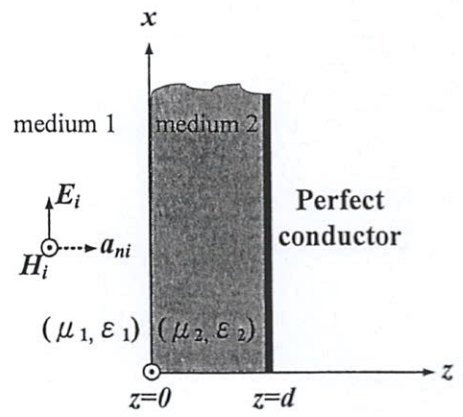
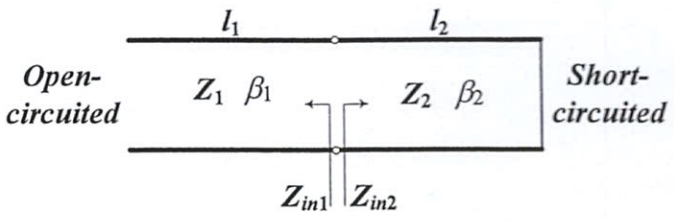
4. Consider the interface structure and its associated fields along with sources shown below. Medium 1 is a dielectric while medium 2 is a perfect conductor. Please write down the boundary conditions of this interface structure. (10%)



5. Consider the plane wave normally incident on the structure shown below. Medium 2 is a dielectric slab (μ_2, ε_2) of thickness d backed by a perfect conductor. (a) Please write down the expression of the input impedance Z_{in}, which is defined by $(E_i+E_r)/(H_i+H_r)$. E_r and H_r are the reflected electric and magnetic fields in medium 1, respectively. (10%) (b) Please write down the expression of the reflection coefficient Γ in medium 1. (10%)



6. Consider two transmission lines connected together shown below. One transmission line is terminated with an open-circuited end and the other transmission line is terminated with a short-circuited end. One transmission line has characteristic impedance Z_1, propagation constant β_1, and length l_1 while the other transmission line has characteristic impedance Z_2, propagation constant β_2, and length l_2. (a) Please write down the expression of the input impedance Z_{in1} looking into transmission line 1. (5%) (b) Please write down the expression of the input impedance Z_{in2} looking into transmission line 2. (5%) (c) Please write down the expression of the resonance condition. (10%)



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