編號： 46

國立成功大學 105 學年度碩士班招生考試試題

系　　所：光電科學與工程學系

考試科目：電磁學

考試日期：0228，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (5%) Please write down Faraday's law in integral form.
   (5%) A uniform magnetic field $B_0(t)$, pointing straight up, fills the shaded circular region of Fig. 1. If it is changing with time, what is the amplitude and direction of the induced electric field?

2. Two long cylinders with radius r_1 and r_2 respectively (Fig. 2) are separated by material of conductivity σ. If they are maintained at a potential difference V and charge per unit length on the inner cylinder is λ.
   (5%) What is the field between the cylinders?
   (5%) What is the current between the cylinders?
   (5%) What is the charge density between the cylinders?

3. (10%) The intensity of sunlight hitting the earth is about 1300 W/m^2. Find the amplitude of the electric and magnetic fields. (Assume the sun's radiation is monochromatic and linear polarized).

4. (15%) For the monochromatic plane wave travelling at the boundary between two linear media (n_1, n_2), Fig. 3, please prove the reflection coefficient R and transmission coefficient T in terms of n_1 and n_2.

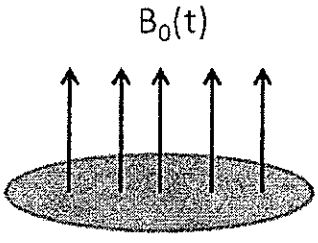

Figure 1

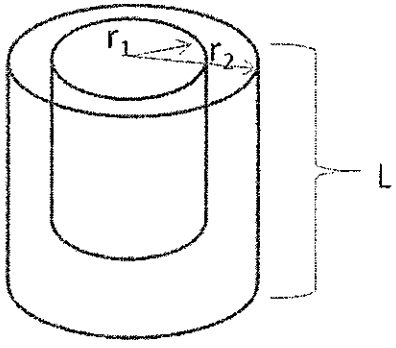

Figure 2

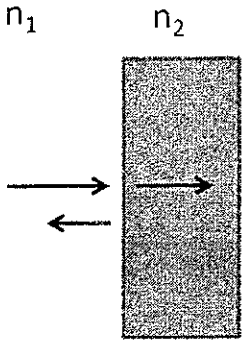

Figure 3

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5. (15%) Figure 4 shows two long parallel wires separated by a distance D and carrying equal current I in opposite directions. Calculate vector potential $\vec{A}$ and magnetic field $\vec{B}$ at point $P(x, y, 0)$ (i.e. at $z = 0$ plane, the distances between P and the two wires are ρ_a and ρ_b, respectively).

6. (10%) Figure 5 shows a vacuum sphere situated in a dielectric material with the relative permittivity of ε_r. When a uniform electric field $\vec{E}$ is applied ($\vec{E} = E\hat{z}$) in the dielectric material, derive the electric field $\vec{E}'$ at the center of the vacuum sphere.

7. A coil of 300 turns is wound on an iron ring ($\mu_r = 500$) of 40 cm mean diameter and 10 cm^2 in cross section.
   (5%) Calculate the magnetic flux in the ring when the current in the coil is one ampere.
   (8%) Calculate the flux when there is a gap of 1.0 mm in the ring.

8. (12%) A parallel-plate capacitor consists of two conducting plates of area S, separated by d. Two dielectric materials of relative permittivities ε_{r1} and ε_{r2} with areas S_1 and S_2 (S=S_1+S_2), respectively, are embedded in the capacitor (Fig. 6). The plates carry charge $+Q_0$ and $-Q_0$. Calculate the energy densities in the two dielectric materials and the total energy in the capacitor.

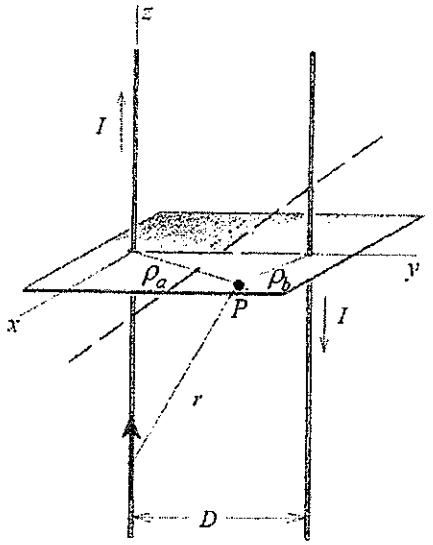

Figure 4

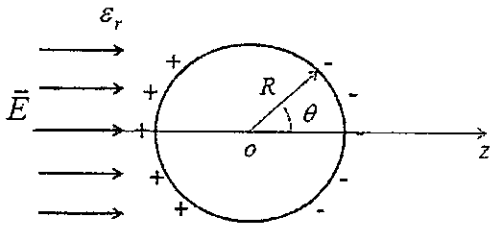

Figure 5

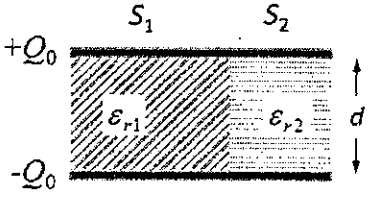

Figure 6