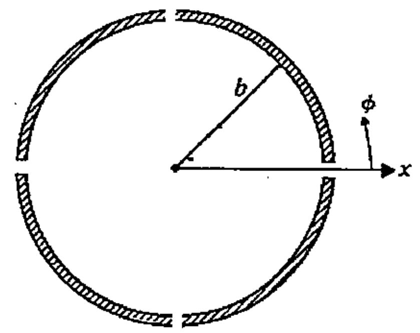
國立成功大學 107 學年度碩士班招生考試試題

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。

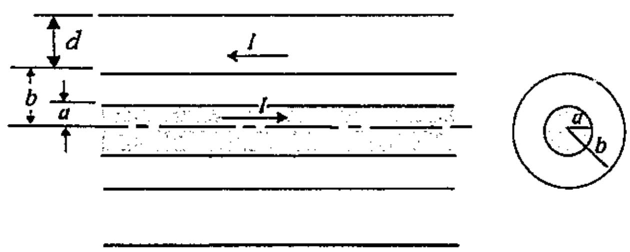
1. (25 %) An infinitely long, thin conducting circular cylinder of radius of b is split in four quarter-cylinders, as shown below. The quarter-cylinders in the second and fourth quadrants are grounded, and those in the first and third quadrants are kept at potentials V_0 and $-V_0$, respectively. Determine the potential distribution both inside and outside the cylinder.



2. (25 %) An air coaxial transmission line, as shown below, has a solid inner conductor of radius a and an outer conductor of inner radius b and thickness d.

   (a) Determine the magnetic flux density in different regions of the line.

   (b) Determine the inductance per unit length of the line.



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3. (20 %) The magnetic field component of a uniform plane wave in air is given by

$$\vec{H}(x) = 2\,e^{j10\pi x}\,[\hat{y}e^{-j\pi/4} - \hat{z}e^{ja\pi/4}] \quad \text{mA} - \text{m}^{-1}$$

where a is a real constant. (a) Find the wavelength λ and frequency f. (b) Find the total time-average power carried by this wave. (c) Determine the type (linear, circular or elliptical) and sense (right- or left-handed) of the polarization of this wave when $a = 1$. (d) Repeat part (c) when $a = 3$.

4. (15 %) As shown in Fig. 1, there is a transverse magnetic (TM) wave with E_z component in a pair of parallel perfect conductor plates. Assume that E_z is not a function of y and satisfy the wave equation:

$$\frac{d^2 E_z}{d x^2} = -k_x^2 E_z$$

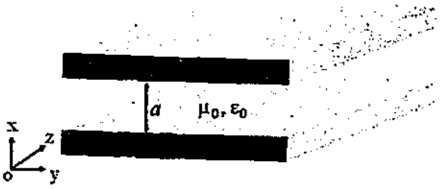

Fig. 1

where $k_x^2 = r^2 + \omega^2 \mu_0 \varepsilon_0$ (r is the propagation constant), please derive its cutoff wavelength and E_x and H_y components.

5. (15 %) As shown in Fig. 2, please derive the reflection coefficient $(\Gamma_\perp)$ for a uniform plane wave oblique incident from medium 1 with perpendicular polarization.

(Hint: $\vec{E}_i(x,z) = \hat{y}\,E_{i0}\,e^{-j\beta_1(x\sin\theta_i + z\cos\theta_i)}$, $\Gamma_\perp = \dfrac{E_{r0}}{E_{i0}}$, E_{r0} is electric field amplitude of reflected wave and $\beta_1 = |k_i|$.)

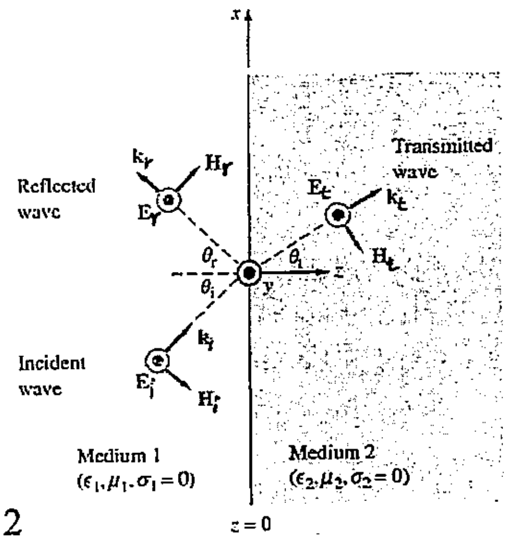

Fig. 2