1. Consider a right-hand circularly polarized (RHCP) wave normally incident on an uniaxial anisotropic dielectric slab from the left, as shown in Fig. 1. If we neglect the effects of reflection at the boundaries $z = 0$ and $z = d$, then, upon exist at $z = d$, the wave is left-hand circularly polarized (LHCP). The operating wavelength of the incident wave in free space is λ, and the permittivity tensor of the anisotropic dielectric is given as $\begin{bmatrix} 64\varepsilon_0 & 0 & 0 \\ 0 & \varepsilon_0 & 0 \\ 0 & 0 & \varepsilon_0 \end{bmatrix}$. Please find the minimal thickness d of the slab. **(10%)**

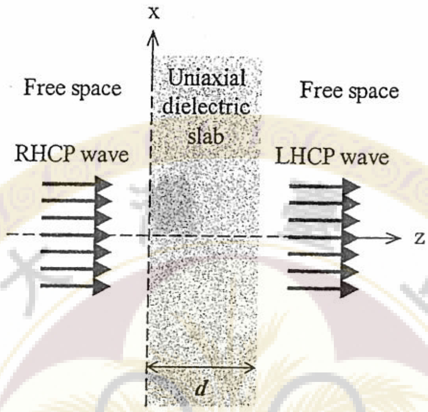


Fig. 1.

2. Derive the expression for the electric field intensity along the z axis of an infinite sheet of uniform ρ_s (C/m^2), as shown in Fig. 2. Note that the infinite sheet contains a hole of a (m) radius. [*Hint*: Use the results of an infinite sheet of uniform charge distribution and a disc of radius a and uniform charge distribution $-\rho_s$.] **(12%)**

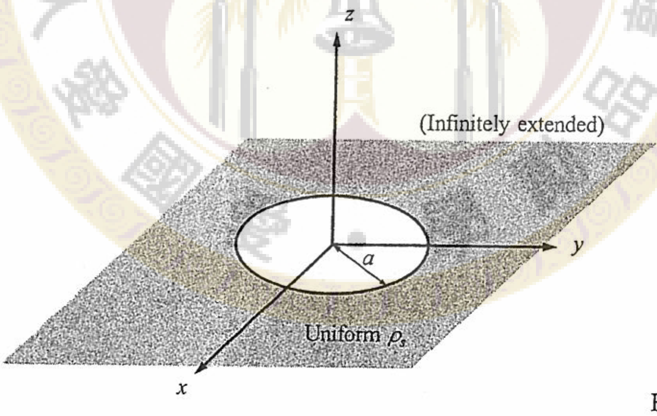


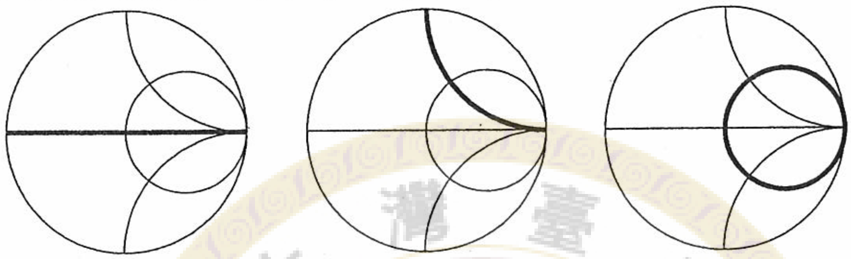
Fig. 2.

3. Given the electric current distribution $\vec{J}$ in vacuum (ε_0, μ_0), please write down the associate time-dependent Maxwell's equations in differential form in terms of the electric field intensity and magnetic flux density. **(8%)**

4. A coaxial cable has a dielectric with ε_r of 4 [$\varepsilon_0 = 8.854\times10^{-12}$ (F/m)]. The inner conductor has a radius of 1.0 mm, and the inside radius of the outer conductor is 5.0 mm. Find the displacement current between the two conductors per meter length of the cable for an applied voltage, $V = 100 \times \cos(12\pi \times 10^6 t)$ (V). **(10%)**

5. Find the static potential distribution ϕ between two infinite parallel plates. One plate is located at $x = 0$ with $\phi = 0$ V, and the other is located at $x = 1$ with $\phi = 1$ V. The space between the plates is filled with a medium having a varying permittivity $\varepsilon(x) = \varepsilon_0(x+1)$ F/m and electric charge density $\rho(x) = \varepsilon_0(2x+1)$ C/m^3. **(10%)**

6. The Smith chart is a transformation from the complex impedance (Z) plane to complex reflection coefficient ( ) plane.
   (a) Derive the real and imaginary parts of in term of the real and imaginary parts of normalized impedance (z), where $z = r + jx$. **(8%)**
   (b) Describe the corresponding normalized impedances of the which are the thick lines on the Smith charts in Figs. 3(a), (b), and (c), respectively. **(12%)**



(a) (b) (c)

Fig. 3.

7.
   (a) Give the definition of the dominant mode for a waveguide. **(3%)**
   (b) Which one of the rectangular waveguide modes is the dominant mode for the waveguide with dimension of $a > b$? **(3%)**
   (c) Explain why the signal with the frequency which is lower than the cutoff frequency of the dominant mode cannot propagate in a rectangular waveguide. **(4%)**

8. What are the standing-wave ratios for a short-circuited line and a semi-infinitely long line? **(10%)**

9. For a parallel-plate waveguide of dimension $a = 5$ cm and having a perfect dielectric of $= 2.25 \; _0$ and $= \; _0$, find the group velocity for a signal composed of two frequencies $f_1 = 2500$ MHz and $f_2 = 3000$ MHz. **(10%)**

試題隨卷繳回