國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：電磁學【光電所碩士班】 題號：435002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘） 共3頁第1頁

1. (Total:15%) The circular arc of radius a shown in Fig.1 lies in the xy plane and has a constant linear charge density λ and center of curvature at the origin. (a)(10%) Find **E** at an arbitrary point on the z axis. (b)(5%) Show that when the curve is a complete circle your answer becomes

$$\mathbf{E} = \frac{\lambda a \vec{z}}{2\epsilon_0 (a^2 + z^2)^{3/2}}$$

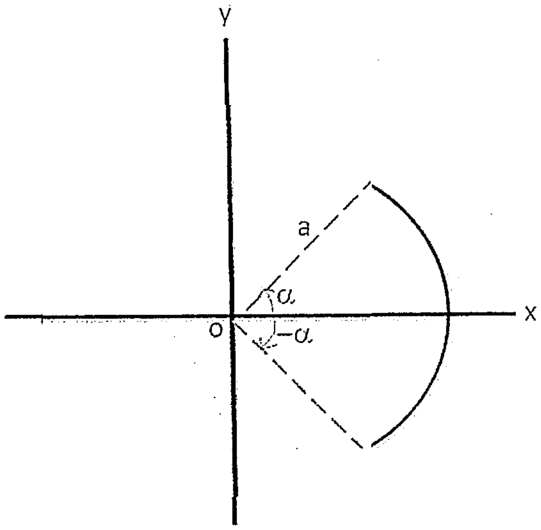

Fig. 1.

2. (Total:15%) (a)(10%) Please find out the potential $\Phi(z)$ in Fig.2 for points on the z axis for positive z. Assume the bound surface charge density on the uniformly polarized sphere is $\sigma_b(\theta') = P\cos\theta'$. (b)(5%) Also please find out the electric field on the z axis outside the sphere (|z|>a).

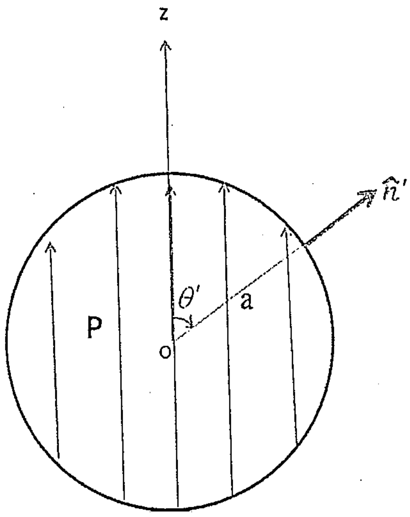

Fig. 2.

3. (10%) Please find the magnetic field a distance z above a long straight wire (finite) carrying a steady current I as shown in Fig. 3.

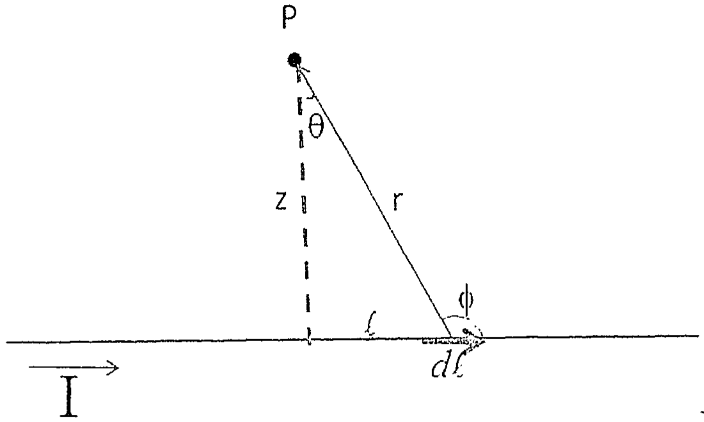

Fig. 3.

4. (15%) Consider the following boundary conditions shown in Fig. 4 and solve the potential $\phi(x, y, z)$ according to the boundary conditions

at x = 0	$\phi(0, y, z) = 0$	plane 1
at x = L	$\phi(L, y, z) = 0$	plane 2
at y = ∞	$\phi(x, \infty, z) = 0$	
at y = 0	$\phi(x, 0, z) = f(x)$	stripe 3

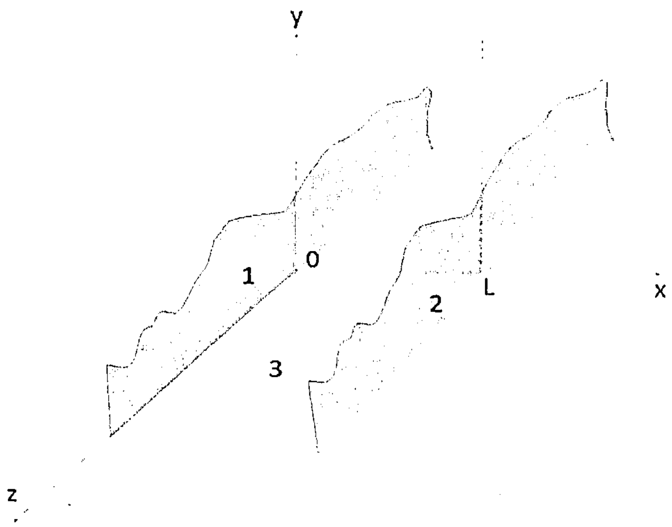

Fig. 4.

5. (Total: 25%) Please refer to Fig. 5. A plane wave traveling in a medium of impedance Z_1 is normally incident at z=0 on a second medium of impedance Z_2. The second medium has thickness L and behind it is another medium of impedance Z_3, which extends to the rest of space. (a)(10%) show that the ratio of the reflected and incident electric field amplitudes in the incident medium is given by

$$\frac{E_{0r}}{E_{0i}} = \frac{Z_2(Z_3 - Z_1)\cos k_2 L - i(Z_2^2 - Z_1 Z_3)\sin k_2 L}{Z_2(Z_3 + Z_1)\cos k_2 L - i(Z_2^2 + Z_1 Z_3)\sin k_2 L}$$

(b)(5%) Show that if $Z_1 \neq Z_3$, the reflected wave will be zero when L equals an odd multiple of a quarter wavelength in medium 2 and $Z_2 = (Z_1 Z_3)^{1/2}$

(c)(5%) Find the corresponding conditions for zero reflected wave when $Z_1 = Z_3 \neq Z_2$

(d)(5%) If light of wavelength $5*10^{-7}$m is normally incident in a vacuum upon a large slab of glass of index refraction 1.5. If the glass is to be coated with a layer of material in order that the light not be reflected, find the required index of refraction and minimum thickness of the coatings.

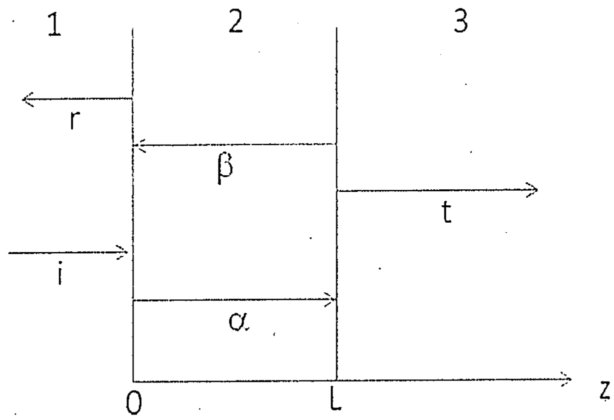

Fig. 5.

6. (20%) Consider the infinitely long coaxial cylindrical conductors shown in Fig. 6. The inner conductor carries a total current I in the $\hat{z}$ direction, while the outer conductor carries a current I in the -$\hat{z}$ direction. Assume the currents to be uniformly distributed over their respective cross sections. Find **B** everywhere and plot your results as a function of ρ(the radial variable).

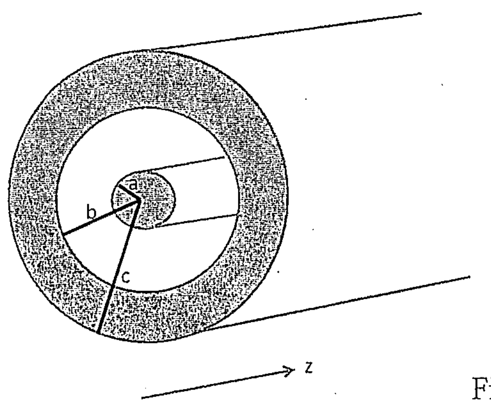

Fig. 6