

國立交通大學 99 學年度台南校區光電學院碩士班入學聯招試題

科目：電磁學(1804)

考試日期：99 年 5 月 8 日 15:10-16:50

系所班別：光電聯招

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【不可使用計算機】\*作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符!!

1. A spherical charge distribution is given by

$$\rho = \rho_0 \left(1 - \frac{r^2}{a^2}\right), \text{ for } r \leq a$$

$$\rho = 0, \text{ for } r > a$$

- (a) calculate the total charge  $Q$ . (7%)

- (b) find the electric field intensity  $\vec{E}$  outside the charge distribution. (7%)

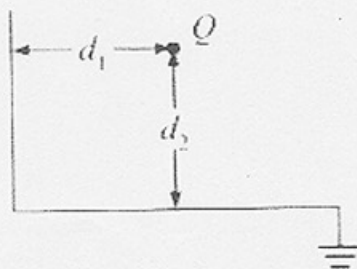
2. Answer the following questions and justify your answer.

Suppose that in the Coulomb's law the strength of the field is inverse cube proportional to distance  $\left(\frac{1}{r^3}\right)$ .

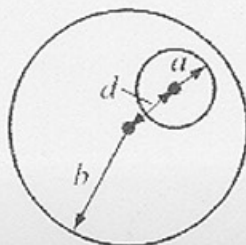
- (a) Is the field still conservative? (6%)

- (b) Is Gauss' law valid? (6%)

3. (a) A positive point charge  $Q$  is located at the distance  $d_1$  and  $d_2$ , respectively, from two grounded perpendicular conducting half-planes, as shown in following figure. Determine the force on  $Q$  caused by the charge induced on the planes. (12%)

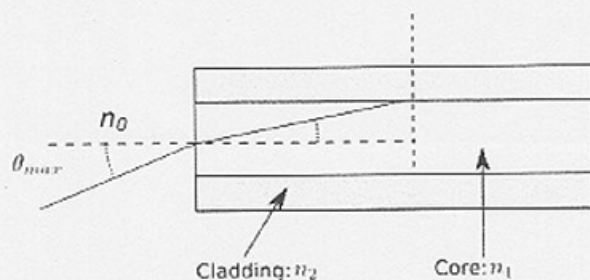


- (b) An eccentric hole of radius  $a$  is bored parallel to the axis of a right circular cylinder of radius  $b$  ( $b > a$ ). The two axes are at a distance of  $d$  apart. A current of  $I$  amperes flows in the cylinder as shown in the following figure. What is the magnetic field at the center of the hole? (12%)



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4. A cladded-core optical fiber is shown below. Please find the maximum angle of incidence in terms of  $n_0$ ,  $n_1$  and  $n_2$ . (12 %)



5. Determine the characteristic resistance  $Z_0$  of a lossless transmission line so that it will have a minimum standing-wave ratio for a load impedance  $60 + j80 \Omega$ . (12 %)
6. A parallel plate waveguide composed of two perfectly conducting plates separated by a dielectric medium with constitutive parameters  $\epsilon$  and  $\mu$  is shown below. Given  $E_y(y) = -\frac{\gamma}{h} A_n \cos\left(\frac{n\pi y}{b}\right)$ .
- (a) Please find the cut-off frequency of the dominant mode of this waveguide. (13 %)
- (b) Find the surface charge densities of the upper and the lower plates. (13 %)

