

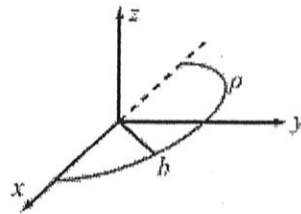
## 國立臺灣科技大學 107 學年度碩士班招生試題

系所組別：電子工程系碩士班丙組

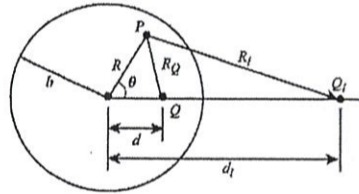
科目：電磁學

(總分為 100 分)

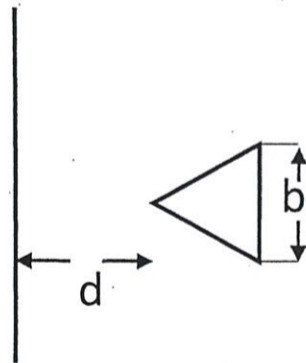
1. A line charge of uniform density  $\rho$  in free space forms a semicircle of radius  $b$ . Determine the electric field intensity at the center of the semicircles (10%).



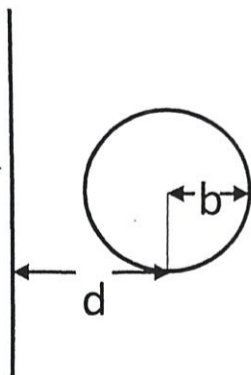
2. A point charge  $Q$  is inside a hollow grounded conducting sphere of radius  $b$  at a distance of  $d$  from the center of the sphere. Please find
- The potential inside the sphere (10%)
  - The induced surface charge density on the surface (10%)



3. a) Determine the mutual inductance between a very long, straight wire and a conducting equilateral triangular loop as shown below (10%)



- b) Determine the mutual inductance between a very long straight wire and a conducting circular loop as shown below. (10%)



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4. If the instantaneous expression of an electric field intensity in a lossless, simple medium is given by  $\vec{E}(x, y, z, t) = \hat{a}_z 10^{-4} \cos(2\pi 10^8 t - \frac{4\pi}{3} y)$  (V/m), determine

- (2%) the polarization
- (2%) the dielectric constant
- (2%) the wavelength
- (2%) the propagation constant
- (2%) the instantaneous expression for the magnetic field intensity

5. For a plane EM wave in medium 1 (with dielectric constant of  $\epsilon_1$ ) being incident on a medium 2 (with dielectric constant of  $\epsilon_2$ )

- (5%) define the critical angle.
- (5%) when does the total reflection exist at an interface of two nonmagnetic media with  $\mu_1 = \mu_2 = \mu_0$ ?

6. The standing-wave ratio on a lossless 50- $\Omega$  transmission line terminated in an unknown load impedance is found to be 3. The distance between successive voltage minima is 20 (cm), and the first minimum is located at 5 (cm) from the load, determine:

- (5%) the reflection coefficient.
- (5%) the load impedance.
- (5%) find the loading impedance if there is a maximum power transfer to the loading.

7. An air-filled  $a \times b$  ( $b < a < 2b$ ) metallic rectangular waveguide is to be constructed to operate at 5GHz in the dominant mode. We desire the operating frequency to be at least 15% higher than the cutoff frequency of the dominant mode and at least 15% below the cutoff frequency of the next higher-order mode.

- (8%) calculate the dimensions  $a$  and  $b$ .
- (7%) calculate the guided wavelength  $\lambda_g$  at the operating frequency.

