

國立臺灣科技大學 112 學年度碩士班招生試題

系所組別：光電工程研究所碩士班

科目：電磁學

(總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分)

1. Charge Q_a is uniformly distributed over a thin spherical shell of radius a , and charge Q_b is uniformly distributed over a second spherical shell of radius b , with $b > a$. Please find the electric field intensity (\vec{E}) in the regions: (15%)
 - (a) $R < a$, (5%)
 - (b) $a < R < b$, (5%)
 - (c) $R > b$, (5%)

2. Let the electric potential $V(x, y) = e^x + f(x) - y^2$ in a region of free space where the volume charge density $\rho_v = 0$. It is known that both the x -component of electric field (E_x) and $V(x, y)$ are zero at the origin. Please find: (15%)
 - (a) $f(x)$, (8%)
 - (b) $V(x, y)$, (7%)

3. An electron having an initial velocity of $3.2 \times 10^7 \hat{i}$ (m/s) enters a uniform magnetic field of magnitude 1.3×10^{-3} (T) with a direction perpendicular to the electron's velocity. It leaves the uniform magnetic field region with velocity $-3.2 \times 10^7 \hat{j}$ (m/s). Please find: (20%)
 - (a) the direction of the magnetic field, (5%)
 - (b) the radius of curvature of the electron's path while in the magnetic field, (5%)
 - (c) the distance the electron traveled in the magnetic field, (5%)
 - (d) the time interval during which the electron is in the magnetic field. (5%)

(Charge of electron = -1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg)



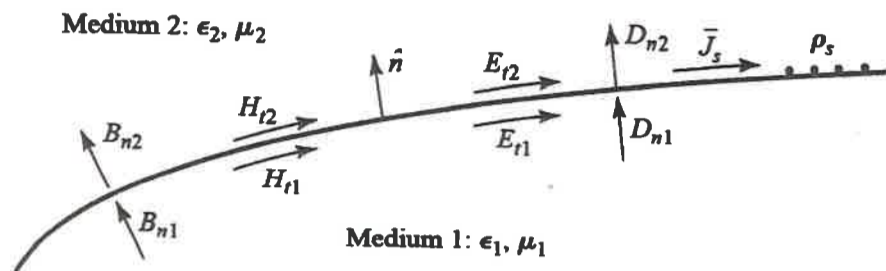
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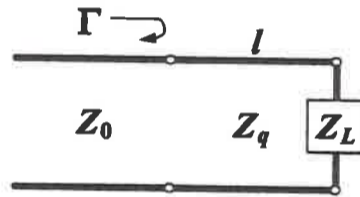
4. (20%)

Consider the sources and fields at the boundary between two media shown below. (a) If medium 1 and medium 2 are dielectric materials, please write down the boundary conditions for the sources and fields (10%) (b) If medium 1 is a perfect conductor and medium 2 is a dielectric material, please write down the boundary conditions for the sources and fields (10%)



5. (20%)

Consider the transmission line circuit shown below. (a) When the length l equals to $\lambda/4$, what should the impedance Z_q be that will make the reflection coefficient Γ zero? (10%) (b) When the length l equals to $\lambda/8$, what should the reflection coefficient Γ be? (10%)



6. (10%)

Consider the plane wave normally incident on the dielectric medium from the free space shown below. Please write down the expressions for the reflection coefficient Γ and transmission coefficient T . (10%)

$$\vec{E}_i = \hat{x} E_0 e^{-jk_0 z}$$

$$\vec{H}_i = \hat{y} \frac{1}{\eta_0} E_0 e^{-jk_0 z}$$

