中原大學 96 學年度碩士班入學考試

96/03/25 14:00~15:30 電子工程學系固態組

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目：基本電磁學 （共 1 頁第 1 頁）

□可使用計算機，惟僅限不具可程式及多重記憶者 ■不可使用計算機

1. (a) Find the electric field inside a uniform charged sphere (charge density ρ and dielectric constant ε_r).**(10%)**

   (b) Two the same spheres carrying uniform charge densities +ρ and −ρ, respectively, are placed partially overlap (figure 1). The vector from the center of −ρ to center of +ρ is $\vec{s}$. What is the field in the region of the overlap? **(10%)**

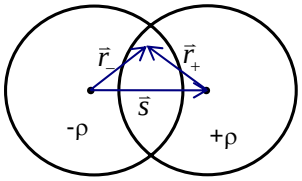

Figure 1

2. (a) Find the magnetic field of a distance **z** $\hat{z}$ above the center of a straight wire (length 2*l*), carrying a steady current ***I*** $\hat{x}$. (The magnetic field of a steady line current is given by the Biot-Savart law: $\vec{B}(z) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{r}}{r^2}$) **(10%)**

   (b) Find the magnetic field of a distance **z** $\hat{z}$ above the center of a square loop (length *s*), carrying a steady current ***I***. **(10%)**

   (c) Show that (b) reduces to the field of a dipole, with the appropriate dipole moment, when **z** >> **s**. (The magnetic field of a dipole **m** put at the origin and let it point in the z-direction: $\vec{B}(r,\theta) = \frac{\mu_0}{4\pi}\frac{m}{r^3}(2\cos\theta\hat{r} + \sin\theta\hat{\theta})$) **(5%)**

3. A mass **m** of point charge ***q*** is released from rest at *z* = **d**. How long will it take for the charge to hit the infinite grounded conducting plane (*z* = 0)?

   $(\int \frac{u^2}{\sqrt{d-u^2}}du = -\frac{u}{2}\sqrt{d-u^2} + \frac{d}{2}\sin^{-1}\left(\frac{u}{\sqrt{d}}\right) + c$ **)(15%)**

4. A cubic box (length π) consists of five square metal planes which are welded together and grounded ϕ = 0 (figure 2). The top is made of a little separate sheet of metal and keep the constant potential ϕ = **V**. Find the potential inside the box. **(20%)**

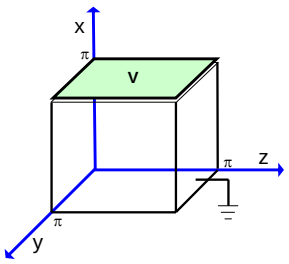

Figure 2

5. In free space, the magnetic field is described by

   $\vec{B} = B_0 e^{ay}\sin\phi\hat{z}$, where $\phi = kx - \omega t$.

   (a) Calculate $\vec{E}$.**(10%)**

   (b) Find the speed of propagation $\vec{v}$ of the field (if the wave remains unchanged during propagation). **(10%)**