國立中央大學 106 學年度碩士班考試入學試題

所別： 機械工程學系光機電工程碩士班 光機組(一般生) 共 1 頁 第 1 頁

科目： 電磁學

本科考試可使用計算器，廠牌、功能不拘 須有計算過程 ＊請在答案卷 內作答

參考用

1. Describe Coulomb's law and its mathematic expression. (8%)

2. Consider an infinite charged sheet with the surface charge density distribution, $\rho_s(x, z)$, on the x-z plane. Assume that the charged sheet is in the free pace. In the $y > 0$ region, the distribution of electric potential is $V(x, y) = e^{-y}\sin x + 2$. Find:
   (a) The electric field intensity $\bar{E}(x, y)$ in the $y > 0$ region. (8%)
   (b) $\nabla \times \bar{E}$. (7%)
   (c) The surface charge density $\rho_s(x, z)$. (10%)

3. A conducting wire of radius $r = 2$ mm has the current density of 5 A/mm^2.
   (a) Find the current of the conducting wire. (6%)
   (b) If this wire connects to a resistor of the resistance $R = 8\ \Omega$, find the power dissipation. (6%)

4. What is the Hall Effect? (5%)

5. As shown in figure 1, a 10 eV electron is circulating in a plane at right angles to a uniform magnetic field B of 1.2×10^{-4} weber/m^2 (=10 gauss).
   (a) What is the velocity v of the electron? (3%)
   (b) What is the orbit radius r of the electron? (7%)
   (c) What is the cyclotron frequency? (5%)
   The mass and charge of the electron are 9.1×10^{-31} kg and 1.6×10^{-19} coul, respectively.

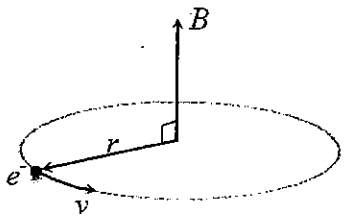

Figure 1

6. Figure 2 shows a hollow cylindrical conductor of radii a and b that carries a current i uniformly spread over its cross section. Show that magnetic field B for points inside the body of the conductor (that is $a<r<b$) is given by $B = \dfrac{\mu_0 i}{2\pi\left(b^2 - a^2\right)}\dfrac{r^2 - a^2}{r}$ (10%)

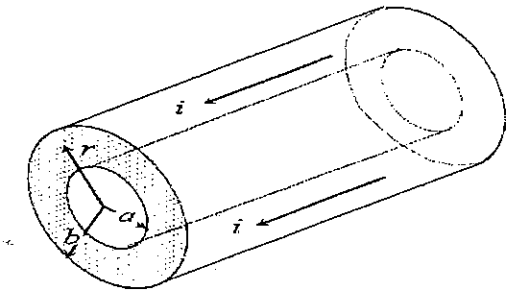

Figure 2

7. Write the general differential form of Maxwell's equations. (8%)

8. (a) State Poynting's theorem. (4 %)
   (b) Define Poynting vector $\bar{P}$. (3 %) What is the SI unit for the vector? (2 %)
   (c) Consider a harmonic, linearly polarized plane wave traveling through free space in the direction of propagation vector $\bar{k}$, drive an expression for the time-average Poynting vector over an interval T (T>> temporal period τ), $\langle \bar{P} \rangle_T$. (8 %)