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國立臺北科技大學108學年度碩士班招生考試

系所組別：2402 光電工程系碩士班

第二節　電磁學　試題（選考）

注意事項：
1. 本試題共5題，每題20分，共100分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. A thin infinite conducting plate carries a surface charge density σ. Show that one-half of the electric field intensity E at a point situated z meters from the surface of the plate is due to the charge located on the plate within a circle of radius $\sqrt{3}z$. (20%)

2. A dielectric sphere of radius R contains a uniform density of free charge ρ. Show that the potential at the center is $\frac{2\varepsilon_r+1}{2\varepsilon_r}\frac{\rho R^2}{3\varepsilon_0}$. (20%)

3. The magnitude flux density $\vec{B}$ for an infinitely long cylindrical conductor is $\vec{B}_1 = \hat{a}_\varphi \frac{\mu_0 r_1 I}{2\pi b^2},\ r_1 \le b\ and\ \vec{B}_2 = \hat{a}_\varphi \frac{\mu_0 I}{2\pi r_2},\ r_2 \ge b$, as shown in Fig.1. Determine the vector magnetic potential $\vec{A}$ both inside and outside the conductor from the relation $\vec{B} = \nabla \times \vec{A}$. (20%)

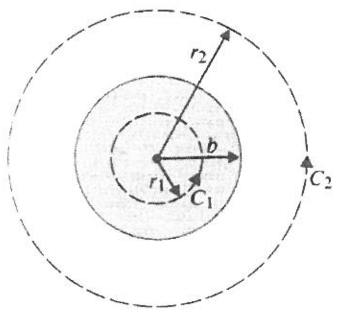

Fig. 1

4. Find the magnetic flux intensity at a point on the axis of a circular loop of radius b that carries a direct current I, as shown in Fig.2.(20%)

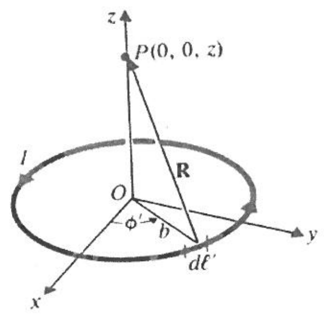

Fig.2

5. A uniform sinusoidal plane wave in air with the following phasor expression for electric intensity $\vec{E}_i(x,z) = \hat{a}_y 10e^{-j(6x+8z)}\ \ V/m$ is incident on the perfectly conducting plane at $z = 0$.
   (a) Find the frequency and wavelength of the wave. (5%)
   (b) Write the instantaneous expressions for $\vec{E}_i(x,z;t)$ and $\vec{H}_i(x,z;t)$, using a cosine reference. (5%)
   (c) Determine the angle of incidence. (5%)
   (d) Find $\vec{E}_r(x,z)$ and $\vec{H}_r(x,z)$ of the reflected wave. (5%)