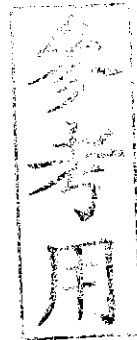


國立中央大學104學年度碩士班考試入學試題

所別：太空科學研究所碩士班 不分組(一般生) 科目：電磁學 共 1 頁 第 1 頁
太空科學研究所碩士班 不分組(在職生)

本科考試禁用計算器

*請在答案卷(卡)內作答



1. The given electric field \vec{E} in spherical coordinates (r, θ, ϕ) is given,

$$\vec{E}(\vec{r}) = \frac{k}{r^3} (2 \cos \theta \hat{r} + \sin \theta \hat{\theta})$$

where k is a constant with the appropriate units and $\hat{r}, \hat{\theta}$ are unit vectors in spherical coordinates r, θ , respectively.

- (a) Sketch the electric field lines in y-z plane. (5%)
 (b) Find the corresponding electrostatic potential field. (5%)
 (c) Sketch the equipotential lines in x-z plane. (5%)
 (d) Find the charge distribution for the electrostatic field. (5%)
2. A conducting sphere of radius R_1 with charge (q) is surrounded a thick concentric conducting shell of inner radius $R_2 (> R_1)$ and outer radius $R_3 (> R_2)$. The shell carries net charge ($-q$).
- (a) Find the surface charge density at R_1, R_2, R_3 . (5%)
 (b) Find the electric energy density. (5%)
 (c) Find the potential at the center of the sphere. (5%)
 (d) Find the capacitance of the system. (5%)
3. There are infinite uniform surface currents, current density (\vec{K}) in z-direction flowing over the $x = 0$ plane, surface current density ($-\vec{K}/2$) flowing over the $x = d (d > 0)$ plane, and surface current density ($-\vec{K}/2$) flowing over the $x = -d$ plane.
- (a) Find the magnetic field at $x > d$. (5%)
 (b) Find the magnetic field at $d > x > 0$. (5%)
 (c) Find the magnetic field at $0 > x > -d$. (5%)
 (d) Find the magnetic field at $x < -d$. (5%)
4. A conducting sphere of radius R with charge Q is spinning with constant angular velocity $\vec{\omega}$ along the y-axis.
- (a) Find the current distribution. (5%)
 (b) Find the magnetic dipole moment of the sphere? (5%)
 (c) Find the magnetic field distribution. (5%)
 (d) Find the electromagnetic energy density. (5%)
5. An alternating current $I(t) = I_0 \sin(\omega t)$ flows down a long straight thin wire and returns along a coaxial conducting tube of radius R . Assuming that the magnetic field goes to zero outside the tube.
- (a) Find the magnetic field under the quasi-static approximation. (5%)
 (b) Find the induced electric field. (5%)
 (c) Find the displacement current density. (5%)
 (d) Find the energy flux density. (5%)