# 國立中央大學103學年度碩士班考試入學試題卷

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　　＊請在試卷答案卷（卡）內作答

1. Given the charge distribution the total electric field produced is calculated,
   (a) For a given charge density $\rho$ over a volume $V$, write the equation by integrating the charge distribution to express the electric potential field at position $\vec{r}$. (5%)
   (b) Write the equation by integrating the charge distribution to express the electric field at position $\vec{r}$. (5%)
   (c) For a given surface charge density $\sigma$ over a surface $S$, write the equation by integrating the charge distribution to express the electric field produced at position $\vec{r}$. (5%)
   (d) For a given uniform line charge density $\lambda$ lying on a thin ring of radius $R$ to calculate the electric field for points on the axis of the ring. (5%)

2. For a solid conducting sphere of radius $R$ and charge $Q$,
   (a) Find the potential field everywhere. (5%)
   (b) Find the electric field everywhere. (5%)
   (c) Find the electric energy of the system. (5%)
   (d) Find the capacitance of the system. (5%)

3. A uniform charged sphere of radius $R$ carries a total charge $Q$, and is spinning with angular velocity $\vec{\omega} = \omega_0 \hat{z}$.
   (a) Find the current density. (5%)
   (b) Find the magnetic dipole moment of the sphere. (5%)
   (c) Find the magnetic field at the center of the sphere. (5%)
   (d) Find the magnetic field at a point $\vec{r}$ where $|\vec{r}| >> R$. (5%)

4. A magnetic dipole of moment $\vec{m}_1$ lies at the position $\vec{r}_1$ and a magnetic dipole of moment $\vec{m}_2$ lies at position $\vec{r}_2$, $\vec{r}_1 \neq \vec{r}_2$.
   (a) Find the magnetic field at the position $\vec{r}_1$. (5%)
   (b) Find the magnetic energy of the system. (5%)
   (c) Find the force between the two dipoles. (5%)
   (d) Find the torque acted on the dipole $\vec{m}_2$. (5%)

5. Inside matter where there is no free charge or free current. If the homogeneous medium is linear isotropic with the permittivity $\varepsilon$ and the permeability $\mu$.
   (a) Write the equations for electric field and magnetic field in the medium. (5%)
   (b) Write the electromagnetic wave equations for waves in the medium. (5%)
   (c) Show that wave travels more slowly than the speed of the wave in vacuum. (5%)
   (d) Show that the wave is transverse. (5%)