國立中央大學八十五學年度碩士班研究生入學試題卷

所別: 地球物理研究所　不分組　科目: 電磁學　共 2 頁 第 1 頁

1. What are the electric potential V and the electric field intensity $\vec{E}$ at a large distance $\vec{r}$ from an electric dipole with dipole moment $\vec{p}$. (18分)

2. What are (a) the vector magnetic potential $\vec{A}$ (b) the scalar magnetic potential V_m and (c) the magnetic induction $\vec{B}$ at a large distance $\vec{r}$ from a magnetic dipole of moment $\vec{m}$. (12分)

3. A point charge Q exists at a distance h above a large grounded conducting plane. Determine: (a) the induced surface charge density σ on the conducting plane. (b) the total charge induced on the conducting plane. (c) the force acting on Q by the conducting plane. (15分)

4. A dielectric sphere with relative permittivity ϵ_r, radius R, contains a uniform density of free charge ρ_f. What are: (a) the volume bound charge density ρ_b inside the sphere? (4分) (b) the surface bound charge density σ_b at the surface? (4分). (c) Determine the electric potential V outside and inside the sphere respectively, setting $V=0$ at infinity. (8分)

5. Write the integral form of Maxwell's equations, and identify each equation with the proper experimental law. (12分)

6. (a) Write the Maxwell's equations in differential form. (4分)
(b) Derive the saurce-free wave equation for $\vec{E}$ and $\vec{H}$ in free space from the Maxwell's equations. (8分)
(c) Determine the speed of electromagnetic wave in free space (4分)

7. Show that the volume charge density ρ in the interior of a conductor will decay as $\rho = \rho_0 e^{-\frac{\sigma}{\epsilon}t}$, where ρ_0 is the initial charge density at $t=0$, σ is the conductivity, and ϵ is the permittivity. (9分)

8. A ferromagnetic sphere of radius R has a uniform magnetization $\vec{M}$ parallel to the z-axis. Calculate the magnetic induction $\vec{B}$ and the magnetic field intensity $\vec{H}$ at the center of the sphere. (12分)