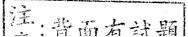
國立中央大學95學年度碩士班考試入學試題卷 共 三 頁 第 一 頁

所別:太空科學研究所碩士班一般生 科目:電磁學

- 1. A point charge q is embedded in a linear, isotropic, and homogeneous dielectric medium of infinite extent. Calculate
 - (a) the electric field intensity \vec{E} , (2 points)
 - (b) the electric flux density \vec{D} , (2 points)
 - (c) the polarization vector \vec{P} , (2 points)
 - (d) the bound surface charge density ρ_{sb} , (3 points)
 - (e) the bound volume charge density ρ_{vb} , (3 points)
 - (f) total charge on the surface of the dielectric next to the charge q. (5 points)
 - (g) total charge which is responsible for the \vec{E} field. (3 points)
- 2. The current density vector \vec{J} changes when passing through an interface between media of conductivities σ_1 and σ_2 .
 - (a) Apply the equation of current continuity $(f_s \vec{J} \cdot d\vec{s} = 0)$ to show the boundary condition, $J_{n1} J_{n2} = 0$, pertaining to the normal component of \vec{J} at an interface. (6 points)
 - (b) Apply conservative \vec{E} field $(f_c \vec{E} \cdot d\vec{l} = 0)$ to show the boundary condition, $\frac{J_{t1}}{\sigma_1} \frac{J_{t2}}{\sigma_2} = 0$, pertaining to the tangential component of \vec{J} at an interface. (6 points)
 - (c) Show that electric field intensity \vec{E} is practically nonexistent in a highly conducting medium $\sigma_1 \gg \sigma_2$. (8 points)
- 3. A proton with mass m and charge q is revolving in a uniform magnetic field $B\vec{a}_z$ (where B>0) with a velocity $\vec{u}=u_p\vec{a}_z+u_n\vec{a}_\phi$. Determine
 - (a) the force acting on the proton, (3 points)
 - (b) the direction of rotation, (4 points)
 - (c) the radius of the orbit, (3 points)
 - (d) the time period, (3 points)
 - (e) the cyclotron frequency, and (3 points)
 - (f) the distance traveled in one period. (4 points)
- 4. (a) What are the integral forms of Maxwell's equations? (4 points)
 - (b) Derive the general wave equation of the $\vec{\mathbf{E}}$ field from the differential forms of Maxwell's equations. (8 points) (Vector Identity: $\nabla \times \nabla \times \vec{\mathbf{F}} = \nabla(\nabla \cdot \vec{\mathbf{F}}) \nabla^2 \vec{\mathbf{F}}$)
 - (c) Under which conditions, the general wave equation will become wave (or Helmholtz) equation? (2 points)
 - (d) What will happen to a plane wave if the wave is propagating in a conducting medium? (2 points)
 - (e) What are the definitions of a good conductor and a good dielectric? (4 points)



國立中央大學95學年度碩士班考試入學試題卷 共二頁第二頁

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- 5. A very long, thin, straight wire located along the z axis carries a current I in the z direction.
 - (a) Find the magnetic flux density and magnetic field intensity at any point in free space using Biot-Savart law. Note that explain Biot-Savart law before you do the calculation. (12 points)
 - (b) Find the magnetic flux density and magnetic field intensity at any point in a magnetic medium with relative permeability μ_r using Ampere's circuital law. Note that explain Ampere's circuital law before you do the calculation. (8 points)