

國立交通大學 96 學年度碩士班考試入學試題

科目：電磁學(2053)

考試日期：96 年 3 月 4 日 第 3 節

系所班別：電信工程學系

組別：電信所乙組

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****作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符!**

1. Explain how a general vector function $\mathbf{F}$ can be expressed in terms of a scalar potential function V and a vector potential function $\mathbf{A}$. (10 points)
2. (a) Is Gauss's law useful in finding the $\mathbf{E}$ field of a finite line charge? Explain. (5 points) (b) What is the boundary condition for electrostatic potential at an interface between two different dielectric media? (5 points)
3. Determine the system of image charges that will replace the conducting boundaries that are maintained at zero potential for an infinite line charge ρ_l located midway between two large, intersecting conducting planes forming a 60-degree angle. (10 points)
4. (a) What is the physical significance of the equation of continuity? (5 points) (b) Define the mutual inductance between two circuits and the self-inductance of a single coil. (5 points)
5. (a) Why is the $\mathbf{E}$ field immediately outside of a perfect conductor perpendicular to the conductor surface? (5 points) (b) Why is the $\mathbf{H}$ field immediately outside of a perfect conductor tangential to the conductor surface? (5 points)
6. The electric field intensity of a linearly polarized uniform plane wave propagating in the $+z$ direction in seawater is $\mathbf{E} = \mathbf{a}_x 100 \cos(5 \times 10^7 \pi t)$ (V/m) at $z = 0$. The constitutive parameters of seawater are $\epsilon_r = 72$, $\mu_r = 1$, and $\sigma = 4$ (S/m). Determine the phase velocity, intrinsic impedance, and skin depth. (10 points)
7. An electromagnetic wave from an underwater source with perpendicular polarization is incident on a water-air interface at $\theta_i = 20^\circ$. Using $\epsilon_r = 81$ and $\mu_r = 1$ for fresh water, find (a) critical angle θ_c , (b) reflection coefficient $\Gamma_\perp$, and (c) transmission coefficient $\tau_\perp$. (10 points)
8. Can TEM wave propagate in a parallel-plate waveguide? Explain. (10 points)
9. What is a log-periodic antenna? Explain the principle of log-periodic dipole arrays. (10 points)
10. Find the input impedance of a low-loss quarter-wavelength line ($\alpha\lambda \ll 1$) terminated in: (a) a short circuit (5 points) and (b) an open circuit (5 points).