

國立交通大學九十學年度碩士班入學考試試題

科目名稱：電磁學(052)

考試日期：90年4月22日 第3節

系所班別：電信工程學系 組別：乙組

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*作答前, 請先核對試題、答案卷(試卷)與准考證上之所組別與考試科目是否相符!!

1. A flat circular ring of radius a contains a uniform charge density λ coul/m. Find the potential and field intensity at any point along the axis. (15 points)
2. In electrostatics no electric field can exist inside an arbitrarily shaped empty cavity bounded by perfect conductor, for whatever charge distribution outside. Explain in rigorous mathematical terms. (15 points)
3. A uniform magnetic cylinder bar of radius a and length L has magnetization M in the axial direction. Plot the field lines of $\mathbf{B}$ as well as $\mathbf{H}$ all over the space, both inside and outside of the bar. (10 points).
4. Can a static magnetic field exist in the interior of a perfect conductor? Explain. Can a time-varying magnetic field? Explain. (10 points)
5. A uniform plane wave ($\mathbf{E}_i$, $\mathbf{H}_i$) of an angular frequency ω is incident from air on a very large, perfectly conducting wall at an angle of incidence θ_i with parallel polarization (i.e., $\mathbf{E}_i$ lying in the plane of incidence). Find (a) the current induced on the wall surface, and (b) the time-average Poynting vector in the air region. (20 points)
6. A generator having an internal resistance of $50\text{-}\Omega$ applies an 150-MHz signal with an open-circuit voltage of $v(t) = 2 \sin(2\pi ft)$ V to a lossless transmission line. The line has a characteristic impedance of $50\text{-}\Omega$ and velocity of propagation of 1.5×10^8 m/s. The transmission line is two-wavelength long at the signal frequency.
 - (a) Determine the per-unit-length inductance and capacitance, phase constant, and actual length, of the line. (4 points)
 - (b) For the case of the matched load, determine and plot the variation of voltage along the entire line at the following time instants: $t = T$, $2T$, and $2.25T$, where T is the period of the signal. (6 points)
 - (c) For the case of short-circuited load, determine and plot the variation of voltage along the entire line at the following time instants: $t = 2T$, $3T$, and $4T$. (6 points)
 - (d) Determine the (steady-state) input impedance at the sending end of the line for the matched and short-circuited load cases, respectively. (2 points)
7.
 - (a) What is meant by a *cutoff frequency* of a waveguide? (3 points)
 - (b) Explain how one determines the phase velocity and the group velocity of a propagating mode in a waveguide from its ω - β diagram. (3 points)
 - (c) Are the field patterns in a cavity resonator traveling waves or standing waves? How do they differ from those in a waveguide? (3 points)
 - (d) Derive the time-harmonic expression for the magnetic vector potential (in spherical coordinates) associated with a Hertzian dipole (i.e., elemental electric dipole antenna). (3 points)