

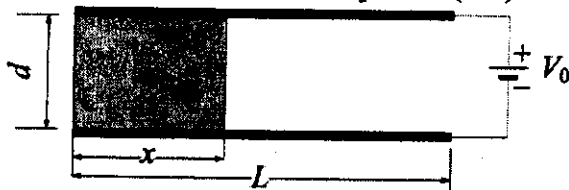
系所組別：光電科學與工程研究所

考試科目：電磁學

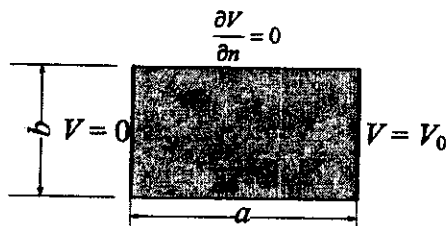
考試日期：0307，節次：2

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1. Assume that the space between the inner and outer conductors of a long coaxial cylindrical structure is filled with an electron cloud having a volume density of charge $\rho = A/r$ for $a < r < b$, where a and b are, the radii of the inner and outer conductors, respectively. The inner conductor is maintained at a potential V_0 , and the outer conductor is grounded. Determine the potential distribution in the region $a < r < b$ by solving Poisson's equation. (10%)
2. A parallel-plate capacitor of width w , length L , and separation d has a solid dielectric slab of permittivity ϵ_r in the space between the plates. The capacitor is charged to a voltage V_0 by a battery. Assuming that the dielectric slab is withdrawn to the position shown below, determine the force acting on the slab
 - (a) with the switch closed; (8%)
 - (b) after the switch is first opened. (7%)



3. Assume a rectangular conducting sheet of conductivity σ , width a , and height b . A potential difference V_0 is applied to the side edges, as shown below. Find
 - (a) the potential distribution; (8%)
 - (b) the current density everywhere within the sheet. (7%)



4. A magnetized compass needle will line up with the earth's magnetic field. A small bar magnet (a magnetic dipole) with a magnetic moment $2 \text{ A}\cdot\text{m}^2$ is placed at a distance 0.17 m from the center of a compass needle. Assuming the earth's magnetic flux density at the needle to be 0.1 mT , find the maximum angle at which the bar magnet can cause the needle to deviate from the north-south direction. How should the bar magnet be oriented? (10%)

(背面仍有題目.請繼續作答)

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5. Two parallel metal plates lying at $y = 0$ and $y = d$ are maintained at electrostatic potentials $\Phi = 0$ and $\Phi = -V_0$, respectively. In addition, a magnetic field $\vec{B} = \hat{z}B_0$ is applied in the region between the plates. Find the magnitude B_0 such that a particle of positive charge q starting at the lower plate ($y = 0$) with initial velocity $\vec{v} = \hat{x}v_0$ (with $v_0 > 0$) will just graze the upper plate at $y = d$. (15%)
6. The length of a Hertzian dipole, whose current I may be considered to be uniform at all points over its length, is denoted to be dl . Note that we have chosen to locate the Hertzian dipole at the origin.
- (a) Determine the phasor retarded vector potential $\vec{A}(\vec{r})$ in the spherical coordinate. (5%)
- (b) Find the instantaneous expression for the magnetic field $\vec{H}(\vec{r}, t)$ of the electromagnetic radiation from this time-harmonic current. (5%)
- (c) Find the instantaneous expression for the electric field $\vec{E}(\vec{r}, t)$ of the electromagnetic radiation from this time-harmonic current. (5%)
- (d) Discuss the electromagnetic fields at near-zone field, defined as $\beta r \ll 1$, and far-zone field, defined as $\beta r \gg 1$, where β is the wave number of the electromagnetic radiation. (5%)
7. The inner dimensions of an air filled K_u -band (12-18 GHz) rectangular waveguide are $a = 1.58$ cm and $b = 0.79$ cm.
- (a) Determine the cutoff frequencies of the five lowest-order modes that can propagate in the guide. (5%)
- (b) Which modes propagate in the K_u -band? (5%)
- (c) Determine the phase velocity and the guide wavelength for TE_{10} mode at 15 GHz. (5%)