國立台灣工業技術學院
八十六學年度碩士班招生考試試題

（命題用紙）
第 1 頁共 2 頁

所別：
學程別：電子工程技術研究所　　組別：系統組　　科目：電磁學

1. (20) A positive charge cloud distribution is given as $\rho = \rho_0(1 - \frac{R^2}{a^2})$ if $R \le a$ and $\rho = 0$ if $R > a$. This charge cloud is at the center of a spherical dielectric shell of inner radius R_i where $R_i > a$ and an outer radius R_o. The dielectric constant of the shell is 3, see Fig. 1
(a) Determine the electric field everywhere. (5 points)
(b) Determine the electric potential everywhere. (5 points)
(c) Determine electric flux density everywhere. (5 points)
(d) Determine the polarization vector everywhere. (5 points)

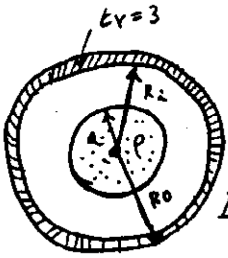

Fig. 1

2. (20) An infinite conducting cone of half-angle α is maintained at potential V_0 and insulated from a grounded conducting plane, see Fig. 2,
(a) Find the potential distribution $V(\theta)$ in the region $\alpha < \theta < \frac{\pi}{2}$. (7 points)
(b) Find the electric field intensity in the region $\alpha < \theta < \frac{\pi}{2}$. (7 points)
(c) Find the charge densities on the cone surface and on the grounded plane. (6 points)

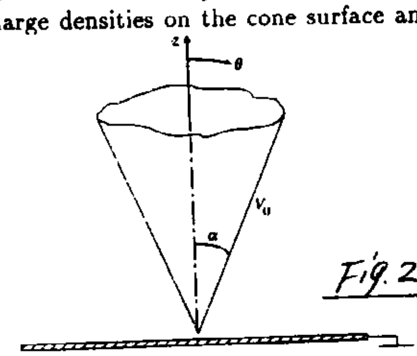

Fig. 2

3. (20) A coaxial cable of inner radius a outer radius b with the carrying current I indicated in Fig. 3.
(a) Find the magnetic field everywhere. (5 points)
(b) Find the internal inductance per meter due to the inner conductor. (5 points)
(c) Find the external inductance per meter between the inner and outer conductors. (5 points)
(d) Find the energy per meter stored in the inner conductor. (5 points)

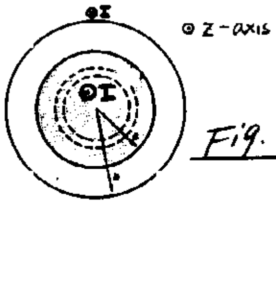

Fig. 3

命題請勿超出線外

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4. (20) A conducting bar can slide freely over two conducting rails as shown in Fig. 4. Calculate the induced voltage in the bar
(a) If the bar is stationed at $y = 8cm$ and $\vec{B} = 4\cos 10^6 t\vec{a}_z mWb/m^2$ (6 points)
(b) If the bar slides at a velocity $\vec{u} = 20\vec{a}_y m/s$, and $\vec{B} = 4\vec{a}_z mWb/m^2$ (7 points)
(c) If the bar slides at a velocity $\vec{u} = 20\vec{a}_y m/s$, and $\vec{B} = 4\cos(10^6 t - y)\vec{a}_z mWb/m^2$ (7 points)

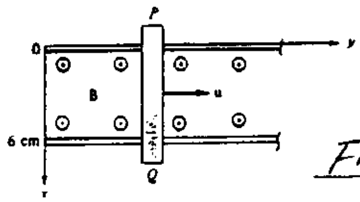

Fig.4

5. (20) A uniform plane wave with $\vec{E}(z,t)$ is polarized along the x-direction, propagates in a lossless, nonmagnetic medium ($\epsilon = 4\epsilon_0$) in the z-direction. Assume $\vec{E}$ is sinusoidal with a frequency 100(MHz) and has a maximum value of 10^{-4} (V/m) at $t = 0$, $z = 0$.
(a) Write the instantaneous expression for $\vec{E}$ for any t and z. (8 points)
(b) Write the instantaneous expression for $\vec{H}$ for any t and z. (6 points)
(c) Write the expressions for the time-average power density of this wave (6 points)

hint:

$$\int \frac{dx}{\sin cx} = \frac{1}{c} \ln \left| \tan \frac{cx}{2} \right|$$

$$\int \frac{dx}{\cos cx} = \frac{1}{c} \ln \left| \tan \left(\frac{cx}{2} + \frac{\pi}{4} \right) \right|$$