

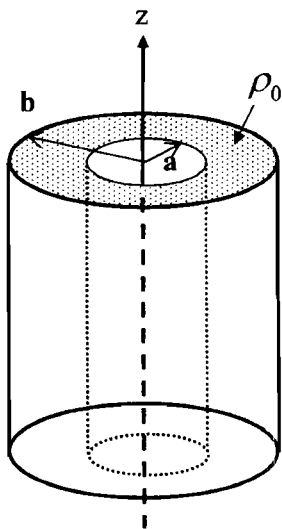
國立台灣科技大學九十八學年度碩士班招生試題

系所組別：光電工程研究所碩士班

科目：電磁學

(總分為 100 分)

1. A cylindrical shell of uniform volume density ρ_0 lies in the region $a \leq r \leq b$.
- (a) Determine the electric flux density \bar{D} in (i) $r < a$, (ii) $a \leq r \leq b$, and (iii) $r \geq b$. (15%)
- (b) What uniform line charge should be placed at $r = 0$ to reduce the external field ($r > b$) to zero. (5%)



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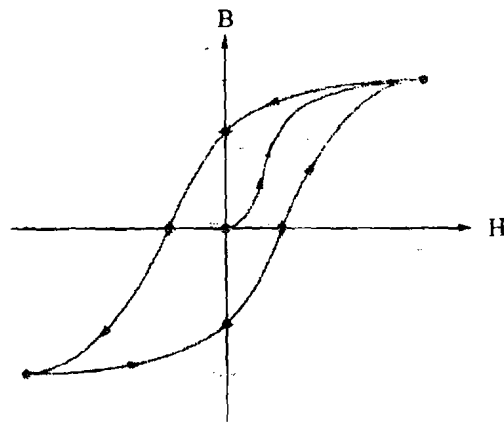
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2. A 10 nC charged particle has a velocity $\vec{v} = \hat{x} 5.0 + \hat{y} 4.0 + \hat{z} 3.0$ (m/sec) as it enters a magnetic field $\vec{B} = \hat{y} 2000$ (T). Calculate
- The force vector on the charge. (8%)
 - What electric field is required so that the velocity of the charged particle remains constant? (7%)

3. (a) Explain the hysteresis loop observed in ferromagnetic materials. (9%)



- (b) Explain difference between "hard" and "soft" ferromagnetic materials. (6%)

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4. In wet soil, characterized by $\sigma = 10^{-2}$ (S/m), $\mu_r = 1$, and $\epsilon_r = 36$.
- Please write down the expression for the conduction current density. (5%)
 - Please write down the expression for the displacement current density. (5%)
 - At what frequency is the conduction current density equal in magnitude to the displacement current density? (5%)
- $$\epsilon_0 = \frac{1}{36\pi} \times 10^{-9} \text{ (F/m)}$$
5. A wave traveling in a nonmagnetic medium with $\epsilon_r = 9$ is characterized by an electric field given by
- $$E = [\hat{y}3 \cos(\pi \times 10^7 t + kx) - \hat{z}2 \cos(\pi \times 10^7 t + kx)] \text{ (V/m)}.$$
- Please determine the direction of wave travel. (5%)
 - Please write down the expression for the magnetic field. (5%)
 - Please calculate the average power density carried by the wave. (5%)
6. A 75Ω losses line is terminated in a load impedance $Z_L = R_L + jX_L$.
- Please write down the equation relating the standing-wave ratio S and the magnitude of the reflection coefficient $|\Gamma|$. (5%)
 - What must be the relation between R_L and X_L in order that the standing-wave ratio on the line be 3? (5%)
7. A standard air-filled S-band rectangular waveguide has dimensions $a = 7.21$ (cm) and $b = 3.40$ (cm). What mode types can be used to transmit electromagnetic waves having the following wavelengths?
- $\lambda = 10$ (cm) (5%)
 - $\lambda = 5$ (cm) (5%)

