中原大學 95 學年度碩士班入學考試

3 月 18 日 14:00~15:30 電子工程系固態組

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目： 基本電磁學 （共 2 頁第 1 頁）

□可使用計算機，惟僅限不具可程式及多重記憶者 ■不可使用計算機

1. (a) Write down the differential form of Maxwell's equations and explain its physics meaning, respectively. In all of the following you must justify your system of units. (16%)
   (b) What happens when you write above equations in vacuum (a source-free medium)? (4%)
   (c) Derive EM wave equations in vacuum. (8%)
   (d) Determine a speed v of the EM wave (wave equation: $\nabla^2 f = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$). (2%)

2. The spherical cavity of radius a is hollowed out from the interior of a conducting sphere of radius b (Fig. 1). A point charge q is placed at the center of the cavity.
   (a) Find the surface charges σ_a and σ_b, respectively. (4%)
   (b) What is the field outside the conductor? (2%)
   (c) What is the field within the cavity? (2%)
   (d) What is the force on q? (2%)
   (e) Which of these answers would change if a second charge, Q were brought near the conductor? (5%)

3. A long coaxial cable carries current I (the current flows down the inner cylindrical conductor and back along the outer cylindrical conducting shell, with radii a and b) and potential difference V between them as shown in Fig. 2.
   (a) Find the magnetic field and the electric field between the conductors, respectively. Neglect the resistance of the cable itself. (8%)
   (b) Find the capacitance per unit length and the inductance per unit length, respectively. (12%)

4. (a) Write down the Lorentz force and explain its physics meaning. (6%)
   (b) What's the difference between the Maxwell's equations and the Lorentz force about charge and field? (4%)
   (c) A rectangular bar of conducting material is placed in a uniform magnetic field $B\hat{z}$ and an electric current density $J\hat{x}$ to flow down the bar as showed in Fig. 3. Find the Hall-field E_y in the steady state. (7%)
   (d) Determine the Hall coefficient in (c), and state the possible applications. (8%)

5. A disc of radius R, carrying a uniform surface charge σ, is rotating at constant angular velocity ω. Find its magnetic dipole moment. (10%)

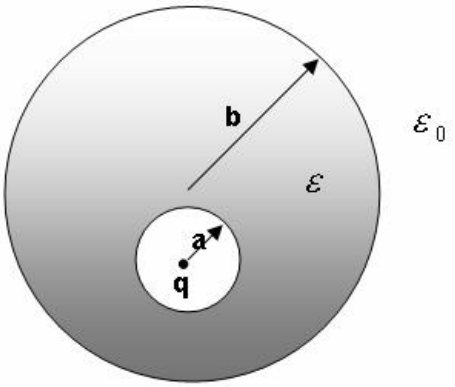

Fig. 1

ε_0

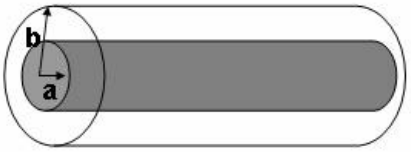

Fig. 2

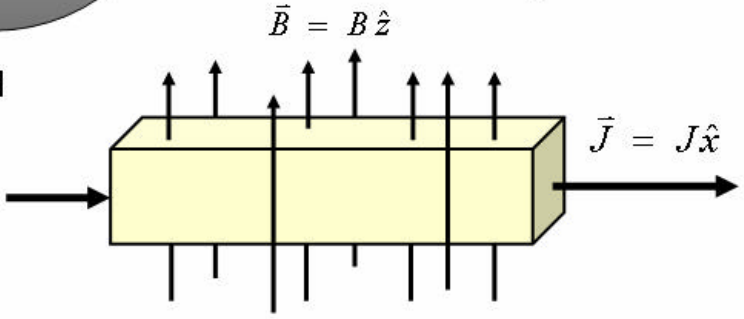

Fig. 3