中原大學 100 學年度 碩士班 入學考試

3 月 19 日 13:30~15:00　　電子工程學系光電半導體組　　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. For a line charge the electric field intensity can be given by

$$\mathbf{E} = \frac{\mathbf{1}}{\mathbf{4}\pi\varepsilon_{\mathbf{0}}} \int_{L'} \mathbf{a}_R \frac{\rho_\ell}{R^2} d\ell' \qquad \text{(V/m)},$$

where ρ_ℓ (C/m) is the line charge density, $\varepsilon_{\mathbf{0}}$ the permittivity of free space, $\mathbf{a}_R$ the unit vector in the radial direction, and L' the line (not necessarily straight) along which the charge is distributed. Find the electric field intensity at a point at a distance r from an infinitely long, straight, line charge of a uniform density ρ_ℓ in air. [15%]

2. A positive point charge Q is at the center of a spherical conducting shell of an inner radius R_i and an outer radius R_o. Determine **E** and V as functions of the radial distance R. [16%]

3. Consider two spherical conductors with radii b_1 and b_2 ($b_2 > b_1$) that are connected by a conducting wire. The distance of separation between the conductors is assumed to be very large in comparison to b_2 so that the charges on the spherical conductors may be considered as uniformly distributed. A total charge Q is deposited on the spheres. Find (a) the charges on the two spheres, and (b) the electric field intensities at the sphere surfaces. [16%]

4. In Fig. 1 a parallel-plate capacitor of area S and separation d is charged to a voltage V. The permittivity of the dielectric is ε. Find the stored electrostatic energy. [14%]

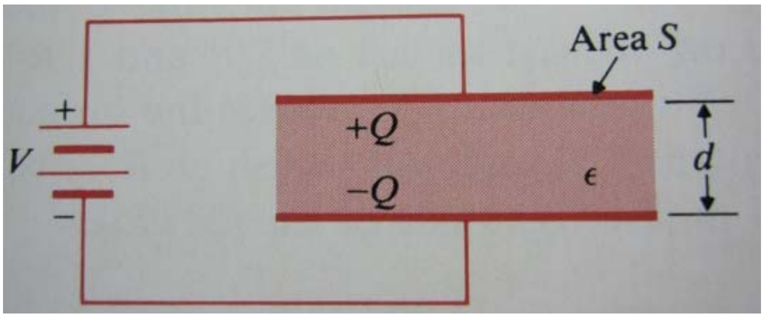

Fig. 1. A charged parallel-plate capacitor.

5. An infinitely long, straight conductor with a circular cross section of radius b carries a steady current I. Determine the magnetic flux density both inside and outside the conductor. [15%]

中原大學 100 學年度 **碩士班** 入學考試

3 月 19 日 13:30~15:00　　電子工程學系光電半導體組　　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 2 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

6. As shown in Fig. 2, two conducting wires are arranged in parallel (*x* direction) with a separation distance of L in uniform magnetic field (magnetic flux density: *B*, +*z* direction) and connected to electrical resistance *R* at the left edge. The conductor bar *P*-*Q* is set on those two conducting wires in parallel with *y*-axis and moved to +*x* direction in constant velocity **v**. Here, contact friction and electrical resistance except *R* are ignored.　　[24%]
   (1) Find the induced electromotive force of this closed circuit.
   (2) Find the current vector (magnitude and direction) flowing through the conductor bar.
   (3) Find the necessary force vector (magnitude and direction) to move the conductor bar in velocity **v**.
   (4) Show that the power of external force to move the conductor bar is equal to the dissipation power of electrical resistance *R*.

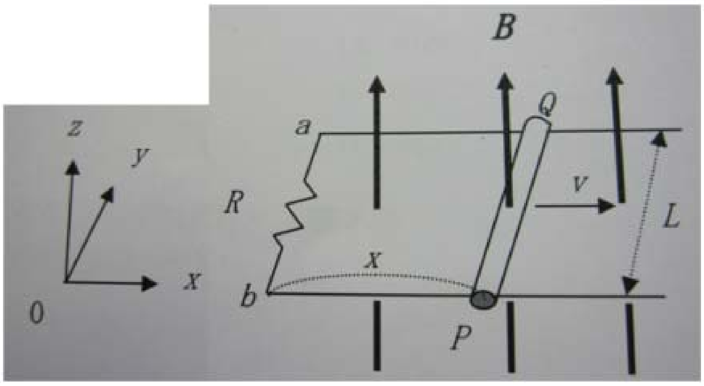

Fig. 2