國立成功大學 104 學年度碩士班招生考試試題

系所組別：生物醫學工程學系乙組

考試科目：電磁學

考試日期：0211，節次：2

※考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. For a Hertzian dipole in a free space as shown in Fig. 1 with the sinusoidal current $i(t) = I \cos \omega t$, determine the components of electric field intensity at point p in spherical coordinate system ($\mathbf{a}_R$, $\mathbf{a}_\theta$, $\mathbf{a}_\phi$). $\mathbf{a}_R$, $\mathbf{a}_\theta$, $\mathbf{a}_\phi$ are all unit vectors. (20%)

2. In a electrostatic deflection system as shown in Fig. 2, an electron is emitted with an initial velocity $\mathbf{u}_0 = \mathbf{a}_z u_0$. The electron enter at $z = 0$ into a region of deflection plates where a uniform electric field $\mathbf{E}_d = -\mathbf{a}_y E_d$ is maintained over a width w. Neglecting the gravitational effect, determine the vertical deflection of electron at $z = L$. (20%)

3. Four capacitors $C_1 = 4$ μF, $C_2 = 3$ μF, $C_3 = 2$ μF, and $C_4 = 1$ μF are connected as shown in Fig. 3. A dc voltage of 100V is applied to the terminal 1and 2. Determine (a) the total equivalent capacitance between terminals 1and 2, (b) the charge on each capacitor, and (c) the potential difference across each capacitor. (15%)

4. Determine the resistance between two concentric spherical surface of radii R_1 and R_2 ($R_1 > R_2$), assuming that a material of conductivity $\sigma = \sigma_0 (1 + k/R)$ fills the space between these two surfaces. (15%)

5. For the vector function $\mathbf{A} = \mathbf{a}_x 3x^2y^3 - \mathbf{a}_y x^3y^2$, (a) determine $\oint \mathbf{A} \cdot dl$ around the triangular contour as shown in Fig. 4, (b) determine $\int (\nabla \times \mathbf{A}) \cdot d\boldsymbol{s}$ over the triangular area, and (c) discuss if $\mathbf{A}$ can be expressed as the gradient of a scalar or not with your explanation in detail. (15%)

6. For a vector magnetic potential $\mathbf{A} = (\mu_0/4\pi) \int_{V'} (\mathbf{J}/R) dv'$, (a) determine the magnetic flux density vector $\mathbf{B}$, and (b) prove $\mathbf{B}$ that satisfies the fundamental postulates of magnetostatics in free space. (15%)

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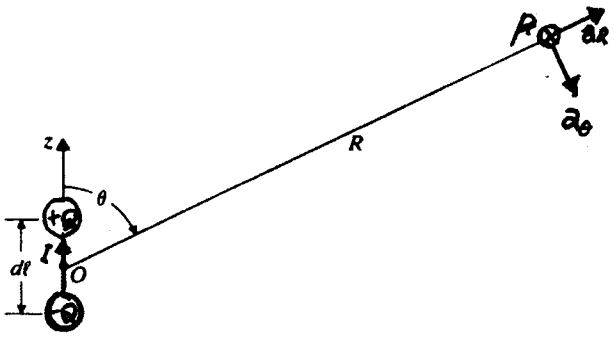

Fig. 1

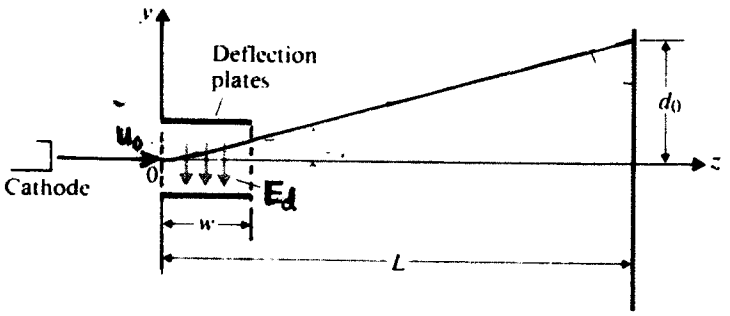

Fig. 2

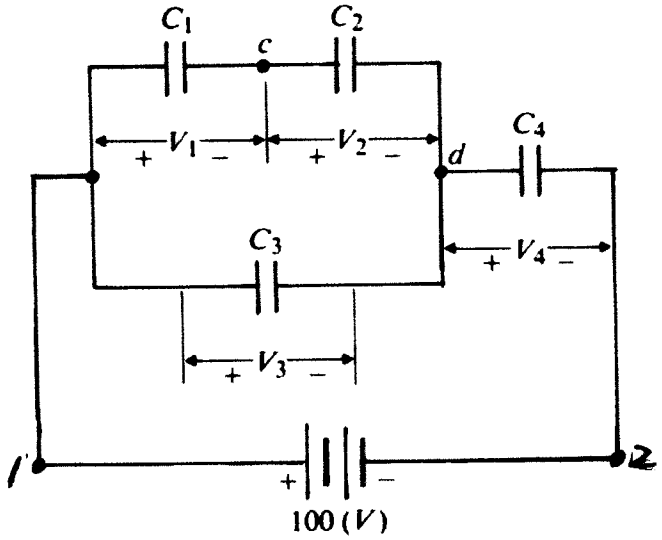

Fig. 3

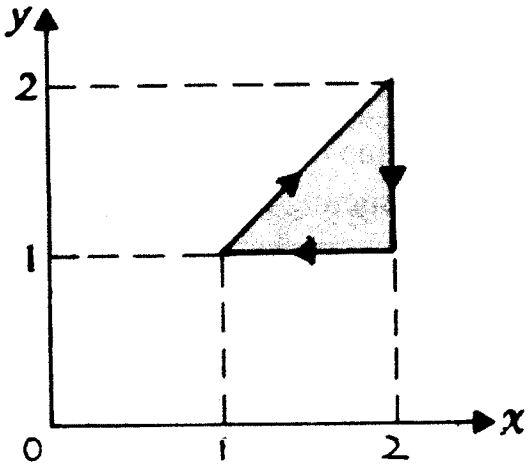

Fig. 4