國立成功大學

112學年度碩士班招生考試試題

編　號：43

系　所：光電科學與工程學系

科　目：電磁學

日　期：0207

節　次：第 2 節

備　註：不可使用計算機

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※ 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. (20 %) There are four infinite plates placed parallel to each other as shown in Fig. 1. The distances between two neighboring plates are a, b and c, respectively. And the two outermost plates are grounded. Now the two middle plates are respectively charged with uniform surface charge density ρ_{S1} and ρ_{S2}. Please find the electric fields **E** in region I, II and III and the electric forces per unit area acting on the plates of ρ_{S1} and ρ_{S2}.

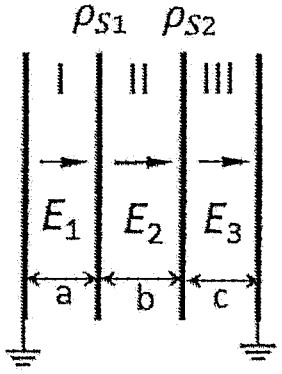

Fig. 1

2. (15 %) A conducting wire is bent as shown in Fig. 2. And a current ***I*** is in the wire. Please find the magnetic flux density **B** at the center *O* of the circular part of the wire.

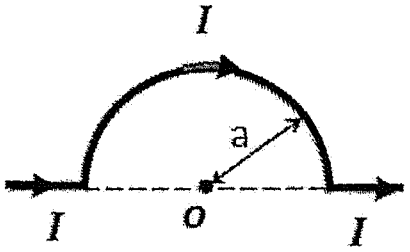

Fig. 2

3. (15 %) A point charge ***q*** (10^{-5} coulombs) moves in a circle with the radius of 1 cm (as shown in Fig. 3). Its angular velocity **ω** is 1000 rad/sec. Please find the displacement current density $\vec{J}$ at the center of the circle.

Hint: $\dfrac{\vec{r}}{r} = \hat{i}\cos\varphi + \hat{j}\sin\varphi$

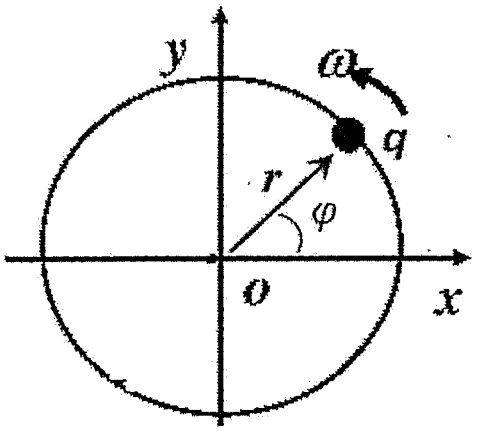

Fig. 3

4. (10%) Consider a circular disk of conducting material spinning about its axis; the disk is immersed in a uniform and constant magnetic field B parallel to this axis. The radius of the disk is R. As the disk turns at the frequency of ν, find the induced emf across the axis and the rim of the disk.

5. (30%) A uniform plane wave with $\vec{E} = \hat{a}_x E_x$ propagates in a lossless simple medium ($\epsilon_r = 4$, $\mu_r = 1, \sigma = 0$) in the +z-direction. Assume that E_x is sinusoidal with a frequency 100 (MHz) and has a maximum value of $+10^{-4}$ (V/m) at $t = 0$ and $z = \frac{1}{8}$ (m).

   a) Write the instantaneous express for $\vec{E}$ for any t and z.

   b) Write the instantaneous express for $\vec{H}$.

   c) Determine the locations where E_x is positive maximum when $t = 10^{-8}$ (s).

6. (10%) Starting from Maxwell's equations, derive the nonhomogeneous wave equations (a) for $\vec{E}$ and (b) for $\vec{H}$ in a simple medium.

   (Hint: Maxwell's equations $\vec{\nabla} \times \vec{E} = -\mu \frac{\partial \vec{H}}{\partial t}$, $\vec{\nabla} \times \vec{H} = \vec{J} + \epsilon \frac{\partial \vec{E}}{\partial t}$, $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon}$, $\vec{\nabla} \cdot \vec{H} = 0$)