國立臺灣科技大學 109 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 uniformly charged rod of length $L$ located along the $x$ axis has a total charge $Q$ as shown in Figure P1. Please find:

   (a) the electric potential, (7%)

   (b) the $x$ component of the electric field, (7%)

   (c) the $y$ component of the electric field, (6%)

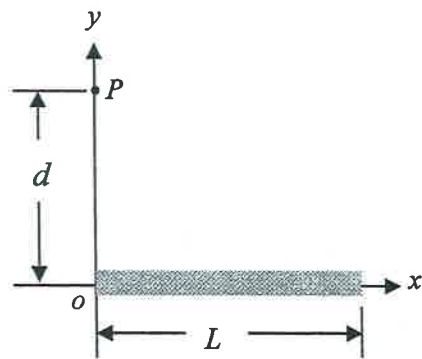   at the point $P$ on the $y$ axis a distance $d$ form the origin.



   Figure P1.

2. Given the spherically-symmetric potential field in free space, $V = V_0 e^{-r/a}$, where $V_0$ is a constant, $a$ is a positive constant, $r$ is the radial distance measured from the origin, please find:

   (a) the volume charge density $\rho_v$ at $r = a$, (7%)

   (b) the electric field at $r = a$, (7%)

   (c) the total charge. (6%)

3. A 5 nC charged particle has a velocity $2.0\,\hat{i} + 5.0\,\hat{j} + 3.0\,\hat{k}$ (m/sec) as it enters a magnetic field $\bar{B} = 1500\,\hat{j}$ (T).

   (a) Calculate the force vector on the charged particle. (5%)

   (b) What electric field is required so that the velocity of the charged particle remains constant? (5%).

4. (a) Please write down the set of Maxwell's equations in time-domain. (5%) (b) What is the criterion that will lead the set of Maxwell's equations into the electric static equations and the magnetic static equations? (5%) (c) Please write down the set of electric static equations. (5%) (d) Please write down the set of magnetic static equations. (5%)

5. Consider the plane wave normally incident on various materials shown below. (a) Please write down the expressions for the reflection and transmission coefficients for Case I. (5%) (b) Please write down the expressions for the reflection and transmission coefficients for Case II. (5%) (c) Please write down the expression for the reflection coefficient for Case III. (5%)
($\varepsilon_0$ and $\varepsilon_r$ : dielectric constant; $E_i$ : electric field intensity; $H_i$ : magnetic field intensity; $a_{ni}$ : incident direction)



Case I　　　　　　　Case II　　　　　　　Case III
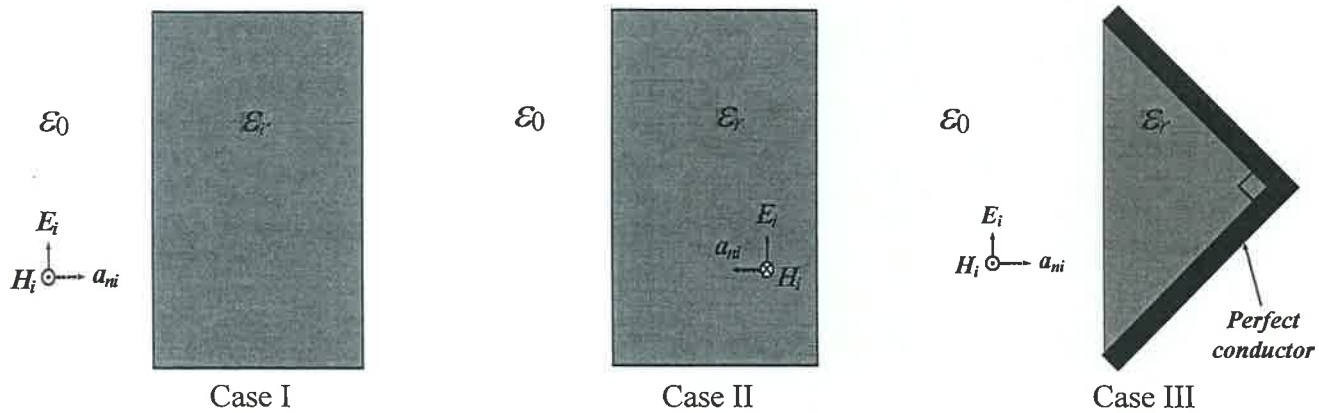
6. Consider the transmission line problems shown below. (a) Please write down the expression for $Z_q$ that will make the impedance matched for Case IV. (5%) (b) With the derived expression for $Z_q$, will the impedance be matched for Case V? (5%) (c) With the derived expression for $Z_q$, please write down the expression for $Z_m$ that will make the impedance matched for Case VI. (5%)
($Z_0$ and $Z_q$: characteristic impedance; $l=\lambda/4$ : electrical length; $Z_m$ and $Z_L$ : impedance)



Case IV　　　　　　　Case V　　　　　　　Case VI