

國立暨南國際大學九十二學年度碩士班研究生入學考試試題

第 2 節電磁學 適用:(通訊所電波組 452)

(本試題共 2 頁, 第 1 頁)

考生注意: 1. 依次序作答, 只要標明題號, 不必抄題。
2. 答案必須寫在答案卷上, 否則不予計分, 並限以藍黑色筆作答。
3. 試題隨卷繳回。(除請詳閱試場規則)

1. A point source, locating at the origin O , radiates electromagnetic wave. In spherical coordinate system, the radiation far field can be described using spherical wave function. If a receiving antenna is at the position A , far away from the origin O . The receiving antenna has a flat aperture having the maximum dimension D for capturing the incoming wave as shown in figure 1. Since the wave front has spherical shape, the phase difference on the aperture of receiving antenna must be present. To quantitatively describe the phase difference, we define the maximum phase error due to the difference of phase at point A and B . Please answer the following questions: (a) Write down the phase difference between point A and B . (b) If the maximum tolerance of the phase error is $\pi/8$, calculate the minimum required distance R (this distance is named as Fresnel Zone distance). (c) Write down the formula to calculate the minimum distance for a given phase error $\delta\phi$ (in the unit of radian). (25%)
2. A plane wave is normally incident on a semi-infinite metallic medium having conductivity σ , as depicted in figure 2. (a) Derive the propagation constant and wave impedance in the metallic medium and express them in terms of skin depth δ ($\delta=1/\sqrt{\sigma\omega\mu_0}$). (b) If the metallic medium has a finite thickness t , calculate the reflection coefficient for the incident plane wave under the two conditions: (1) t is much smaller than δ (thin metal plate), and (2) t is much larger than δ (thick metal plate). (25%)
3. An electric charge $+Q$ is above the PEC (Perfect Electric Conductor) filled with the semi-infinite plane as shown in figure 3. From the image theory, the image charge $-Q$ is below the interface and has the same distance to the origin (O) as that of charge $+Q$ (the distance is h). Please describe and explain the direction of image electric current for vertically and horizontally placing above the PEC, respectively. (25%)
4. There is a parallel-plate waveguide consisting of a PEC (Perfect Electric Conductor) and a PMC (Perfect Magnetic Conductor) plates as its waveguide walls. The separation distance between the two plates is h . The widths of the two plates are assumed to be w , which is much greater than the operation wavelength. Consequently, the field is assumed to have no variation along the direction of width (y axis). Write down the electric and magnetic fields in such a uniform waveguide for both TE and TM polarizations (the waveguiding direction is along z axis). (25%)

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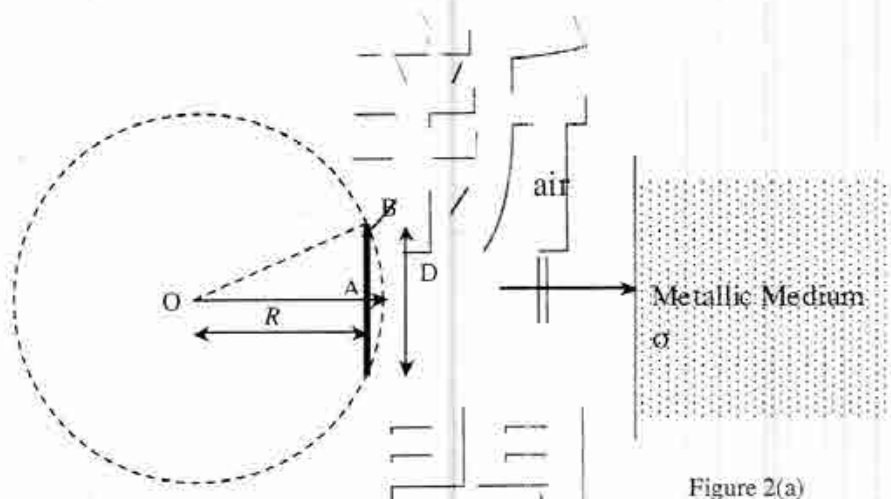


Figure 1

Figure 2(a)



Figure 2(b)

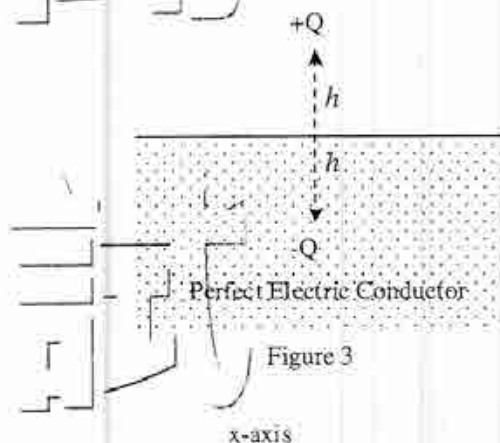


Figure 3

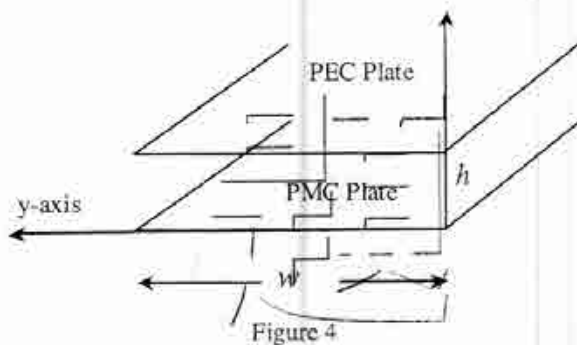


Figure 4