

國立臺灣科技大學 108 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. An electron is launched at a 45° angle and a speed of $5\sqrt{2} \times 10^6$ m/s from the positive plate of the parallel-plate capacitor shown in Figure P1. The electron lands 5.0 cm away. Assume the electric field is uniform at every point between the plates inside the capacitor.

(Charge of electron: -1.6×10^{-19} (C), Mass of electron: 9.1×10^{-31} (kg))

- (a) What is the electric field intensity inside the capacitor? (10%)
 (b) What is the smallest possible spacing between the plates? (10%)

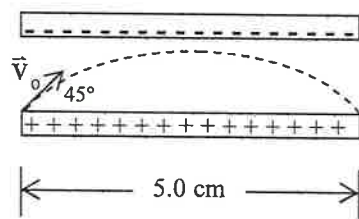


Figure P1.

2. The electric potential in a material with the relative permittivity $\epsilon_r = 10.0$ is $V = 5x^2y$ (V).

(The free space permittivity $\epsilon_0 = 8.85 \times 10^{-12}$ (F/m))

Find (a) the electric field intensity (\vec{E}) (5%)

(b) the electric flux density (\vec{D}) (5%)

(c) the polarization vector (\vec{P}) (5%).



3. A long cylindrical conductor whose axis is coincident with the z-axis has a radius a and carries a current characterized by a current density $\vec{J} = \frac{1}{2} \frac{J_0}{e^r} \hat{z}$, where J_0 is a constant and r is the radial distance from the axis of cylinder. Obtain an expression for the magnetic field intensity (\vec{H}) for

(a) $0 \leq r \leq a$ (8%)

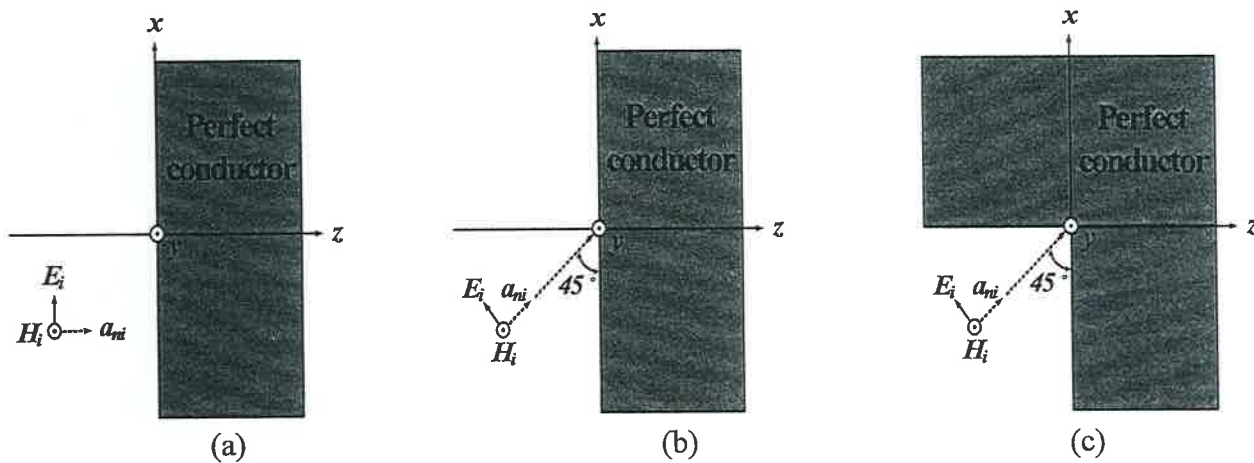
(b) $r \geq a$ (7%).

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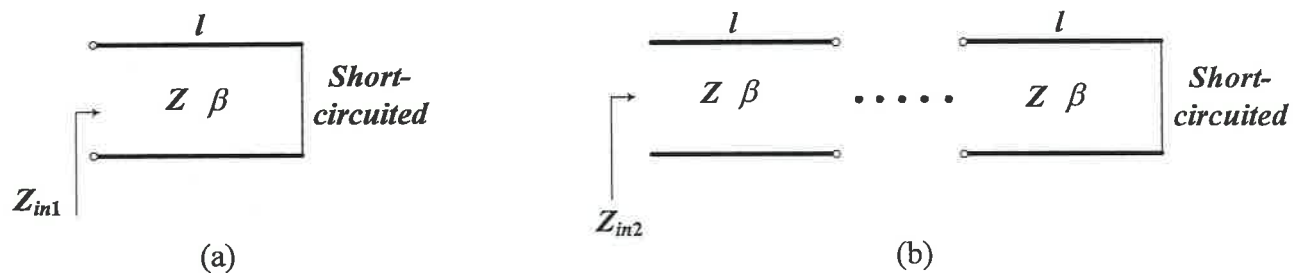
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4. Consider the plane wave incident on the infinitely perfect conductor shown below. Please calculate the reflection coefficients for the following cases. (a) The plane wave is normally incident on the perfect conductor. (5%) (b) The plane wave is incident on the perfect conductor with an angle of 45 degrees. (5%) (c) The plane wave is incident on the right-angled conductor with an angle of 45 degrees. (10%)



5. Please calculate the input impedance for the following transmission line circuits. (a) The transmission line with a length l , characteristic impedance Z , and propagation constant β , is terminated with the short-circuited load. (10%) (b) The transmission line with a length l , characteristic impedance Z , and propagation constant β , is infinitely duplicated and connected. The end of the transmission line is terminated with the short-circuited load. (10%)



6. Consider the rectangular waveguide shown below. (a) Please write down the expression for the cutoff frequency of the TE and TM modes of the rectangular waveguide. (5%) (b) What is the cause of the cutoff frequency of the rectangular waveguide? (5%)

