

* 作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符!!

- (10%) Please write down Maxwell equations in the form of differential equations, and explain the physical meaning of each equation.
- (15%) Consider the region enclosed on three sides by grounded conducting planes shown in Fig. 2. The end plate on the left is insulated from the grounded sides and has a constant potential V_0 . All planes are assumed to be infinite in extent in the z -direction. Used separation of variable method, determine the potential distribution within the region.

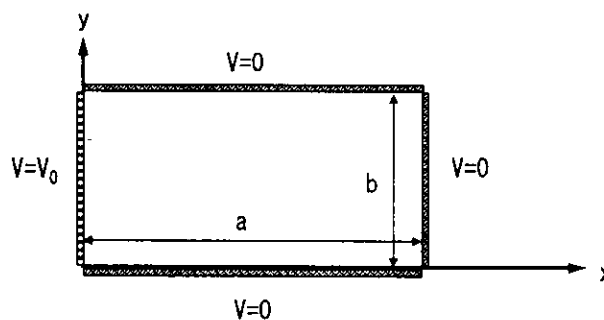


Figure 1: Cross section of potential box

- Consider a straight, thin conductor in air parallel to and at a distance d above the plane interface of a magnetic material of relative permeability μ_r . A current I flows in the conductor.

- (15%) Show that all boundary conditions are satisfied if

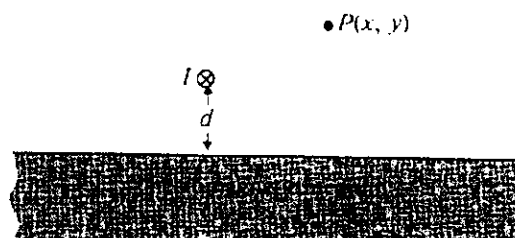
- the magnetic field in the air is calculated from I and an image current I_i ,

$$I_i = \left(\frac{\mu_r - 1}{\mu_r + 1} \right) I$$

and these currents are equidistant from the interface and situated in air;

- the magnetic field below the boundary plane is calculated from I and $-I$, both at the same location. These currents are situated in an infinite magnetic material of relative permeability μ_r .

- (10%) For a long conductor carrying a current I and for $\mu_r \gg 1$, determine the magnetic flux density B at the point P in the figure.



A current-carrying conductor near a ferromagnetic medium

國立交通大學 97 學年度碩士班考試入學試題

科目：電磁學(1502)

考試日期：97 年 3 月 8 日 第 3 節

系所班別：光電、顯示系所跨所聯招

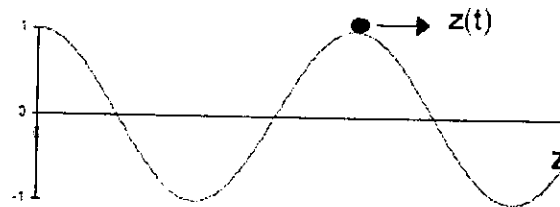
組別：光顯聯招

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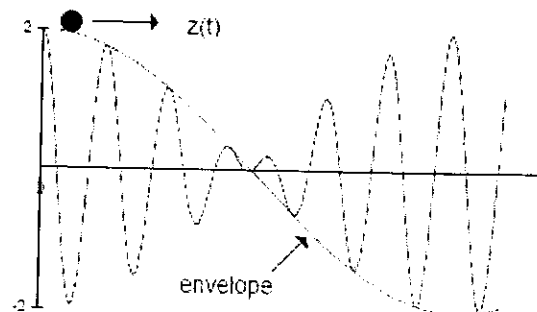
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4. Please answer the following questions

- (a) The velocity of light propagation at free space ($c = 3 \times 10^8$ m/s) depends on two physical constants, please state these two constants and the equation relating these two constants and c . (5%)
- (b) Please define transverse electromagnetic (TEM) wave. (5%)
- (c) The electric field intensity of a linearly polarized uniform plane wave propagating in the $+z$ direction is $E = 10 \cos(10^7 \pi t)$ (V/m). Find the angular frequency (rad/s) and the frequency (Hz) of the wave. (5%)
- (d) Phase velocity [$u_p = \frac{\omega}{\beta}$ (m/s)] describes the motion of a point, line or surface of constant phase for waves in one, two and three dimensions respectively, as shown in the figure below, where ω is the angular frequency and β is the phase constant or propagation constant. Given the $\beta = 8.89$ rad/m, please find the phase velocity and the wavelength of the wave. (5%)



- (e) Given that a wave packet consists of two traveling waves having equal amplitude and slightly different angular frequency $\omega_0 + \Delta\omega$ and $\omega_0 - \Delta\omega$, where $\Delta\omega \ll \omega_0$, as shown in the figure below. The phase constants, being functions of frequency, will also be slightly different. Assume the phase constants corresponding to the frequencies be $\beta_0 + \Delta\beta$ and $\beta_0 - \Delta\beta$. Derive the group velocity equation. (5%)



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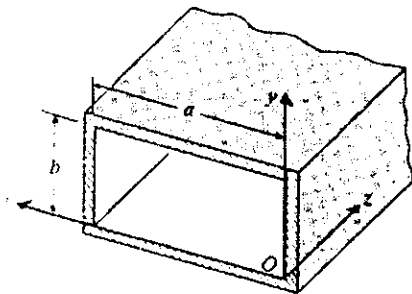
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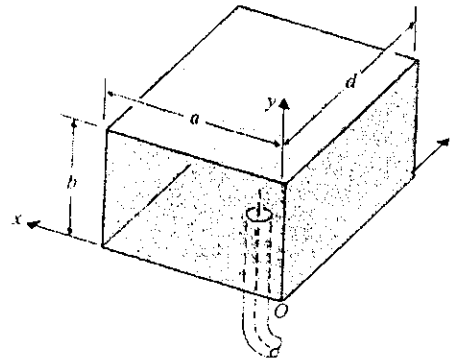
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5. An air-filled lossless rectangular waveguide with brass walls - ϵ_0 , μ_0 , $\sigma=1.57 \times 10^7$ (S/m) has the following dimensions: $a=2$ (cm), $b=1.5$ (cm).
- (a) Determine the dominate mode, and what is the allowable operation frequency range with 10% above the dominate cut-off frequency and no higher than 95% of the next higher cut-off frequency? (10%)
- (b) If the waveguide was cut and made as a cavity resonator which has $d=2.5$ (cm), and filled with a lossless dielectric material having $\epsilon=2.5$; Please determine the dominated mode and its resonant frequency for the cavity. (5%)

(a) Waveguide



(b) Cavity



6. For the YUGI-UDA ANTENNAS (八木-宇田 天線), please answer the following questions:
- (a) What is the most usual application the YUGI-UDA ANTENNAS. (3%)
- (b) Please explain the functions of the three components, reflector, active element, and director. (7%)

