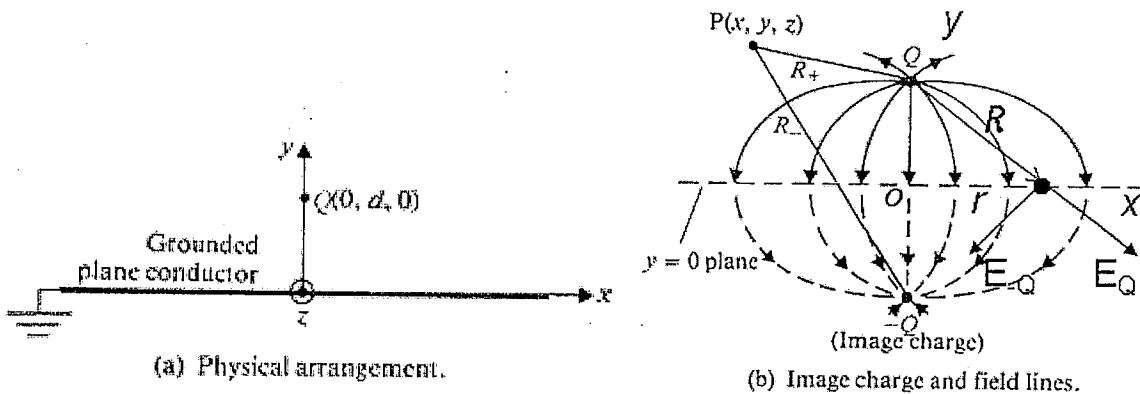


Problem 1

- (10%) Using the Method of Image, write down the potential distribution, $V(x, y, z)$, for a point $P(x, y, z)$ in space, as shown in Figure (a), in terms of R_+ and R_- , as indicated in Figure (b). The dielectric constant of the space is ϵ_0 .
- (10%) Write the electric intensities ($E_x|_{y=0}$, $E_y|_{y=0}$, and $E_z|_{y=0}$) for a point on the ZX -plane in terms of d and R , or d and r , as indicated in (b).



Figures (a) and (b) a single charge Q above a ground plane

Problem 2

A air-filled coaxial with dimensions as shown in the following figure:

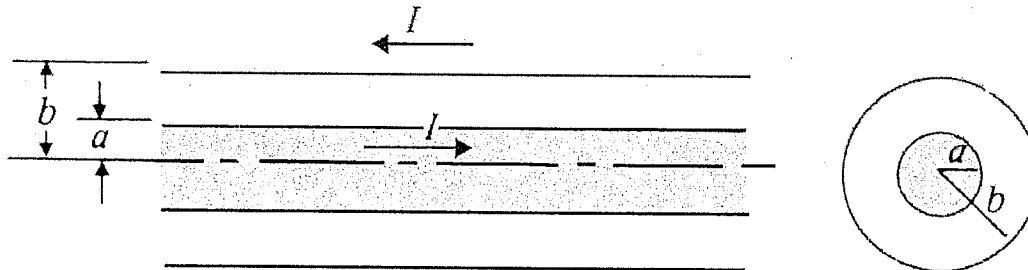


Figure (c) a coaxial transmission line with signal carrying conductor of radius a inside the surrounding ground of radius b .

The inductance per unit length is $L' = \frac{\Lambda'}{I} = \frac{\mu_0}{8\pi} + \frac{\mu_0}{2\pi} \ln \frac{b}{a}$ (H/m). Here we have assumed that the current inside the signal-carrying conductor is uniformly distributed. And, the capacitance per unit length is

$$C' = \frac{2\pi\epsilon_0 L}{\ln\left(\frac{b}{a}\right)} \text{ (F/m)}.$$

- (5%) For the inductance, which term drops off at high frequencies? Why?
- (5%) The characteristic impedance is defined as $Z_c = \sqrt{\frac{L'}{C'}}$, find out the characteristics impedance at high frequencies, and please indicate the unit for it.

國立中山大學 102 學年度碩士暨碩士專班招生考試試題

科目名稱：電磁學【電機系碩士班戊組、電波領域聯合】

題號：431012

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）

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Problem 3

- (5%) The dielectric constant for Teflon is 2; it is a low one for a dielectric material. What is the dielectric constant for air?
- (5%) What is the dielectric constant for a metal, for example, Copper?
- (5%) Explain the difference between a dielectric and a conductor.
- (5%) The relative permeability for Steel is 100, and is frequency dependent. What is the relative permeability for Copper?

Problem 4

(10%) Refer to the following figure and prove the law of Cosines, $C = \sqrt{A^2 + B^2 - 2AB \cos \alpha}$.

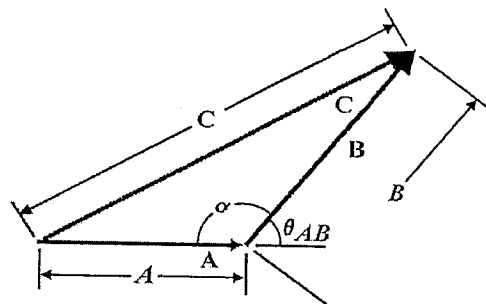


Figure (d) Illustrating example for Problem 4

Problem 5

(15%) A parallel polarized plane wave is obliquely incident from free-space onto a magnetic material with permittivity ϵ_0 and permeability $\mu_0\mu_r$. Find the reflection coefficient, transmission coefficient, and Brewster angle.

Problem 6

(15%) A 50Ω transmission line is matched to a 10V AC source and feeds a load $Z_L = 100 \Omega$. If the line is 2.3λ long and has an attenuation constant $\alpha = 0.5 \text{ dB} / \lambda$. Find the powers that are delivered by the source, lost in the line, and delivered to the load.

Problem 7

(10%) For a rectangular waveguide that supports TE_{10} mode, explain why a narrow slot can be cut along the centerline of the broad wall of the rectangular waveguide without perturbing the propagation of the TE_{10} mode.