Fundamentals of Electromagnetic Fields– Prof. C. Riva
February 3, 2014

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NAME AND SURNAME _____

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Exercise 1

Let $Q = 10^{-3}$ C be a point charge in the axes origin (see figure), and let ρ_Ω be the following volumetric charge distribution (spherical shell as shown in figure):

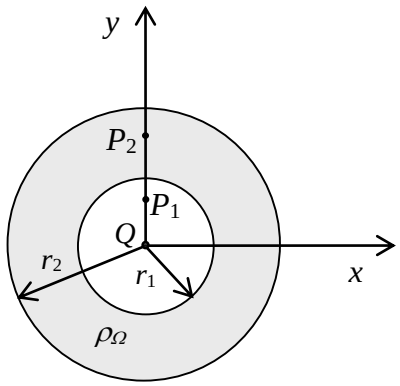
$\rho_\Omega = -0.01\ \mathrm{C/m^3} \qquad r_1 \le r < r_2$

with r_1=15 cm and r_2=30 cm.

Calculate the force vector acting on a point charge q =- 10^{-6} C when placed in:

a) P_1(0, 10 cm);

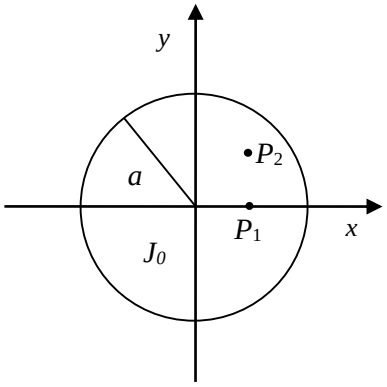
b) P_2(0, 25 cm).



Solution:

Exercise 2

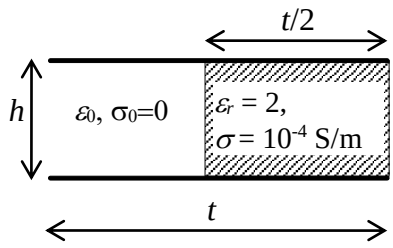
A cylindrical conductor (axis coincident with *z* axis, radius *a*=4 cm) is crossed by an electric current whose volumetric density is $J_0 = 200\, r\, \vec{a_z}$ (A/m^2), where *r* is the distance from the cylinder axis. Calculate the magnetic field vector $\vec{H}$ in P_1(*x* = 2 cm, *y* = 0) and P_2(*x* = 2 cm, *y* = 2 cm).



Solution:

Exercise 3

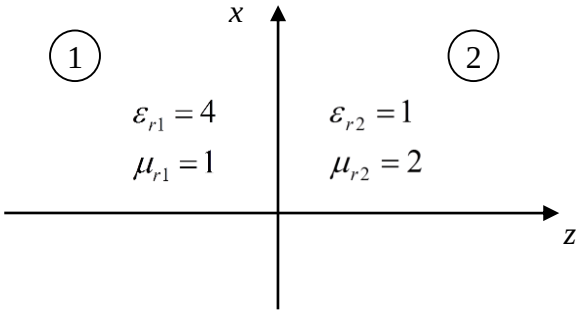
Given the microstrip in figure ($\mu = \mu_0$ everywhere, h=1 mm, t=5 mm), calculate the attenuation constant α expressed in dB/km at the frequency f=300 MHz, due to only dielectric losses (conductors must be considered as perfect conductors).



Solution:

Exercise 4

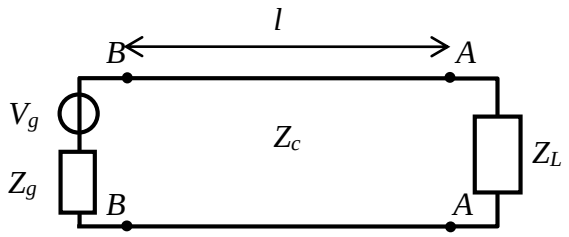
A uniform plane wave, at 300 MHz frequency, is propagating in +*z* direction in the dielectric 1 $(\varepsilon_{r1}=4,\mu_{r1}=1)$ and orthogonally incident on the dielectric 2 $(\varepsilon_{r2}=1,\mu_{r2}=2)$ (see figure). Assuming that the phasor of the incident electric field in the axis origin is $\vec{E}_i(0,0,0)=10\,\vec{a}_x\ (\mathrm{V/m})$, write the expressions of the phasors of the total electric and magnetic fields everywhere (in dielectric 1 and 2).



Solution:

Exercise 5

A signal generator (Z_g = 50 Ω, P_{av} = 10 W), operating at 150 MHz frequency, is connected to a load having an impedance Z_L = 75 Ω through a lossy transmission line, with characteristics impedance Z_c=75 Ω, attenuation constant α=30 dB/km and length l = 30 m (see figure). Calculate the power dissipated by the load and the power lost along the line.



f = 150 MHz
Z_g = 50 Ω
P_d = 10 W
Z_L = 75 Ω
Z_c = 75 Ω
α = 30 dB/km
l = 30 m

Solution: