FUNDAMENTALS OF ELECTROMAGNETIC FIELDS – July 21, 2017

Name:
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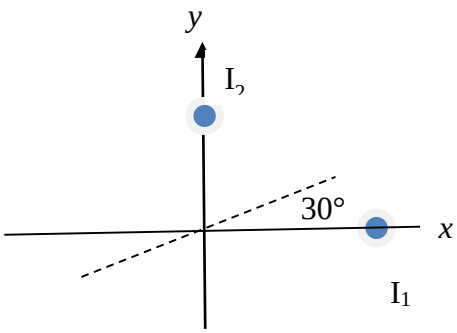
Problem 1 - Consider a uniformly charged cylinder of radius 2 cm and placed at the center of the coordinate system. Suppose you know that the potential at P_1(3 cm, 4 cm) is V_1 = 3 V and at P_2(4 cm, 4 cm) is V2 = 2.5 V. Find

- The charge density on the cylinder;
- The electric field at P_1.

Problem 2 - Consider the system of two z-directed currents in the figure, in which $I_1 = -1$ A and $I_2 = 2$ A. Current I_1 is placed at (2 cm, 0), current I_2 is placed on the y-axis. Find

- the position of current I_2 such that the magnetic field at the origin is directed along the dashed line (30° degrees inclination)
- in the final configuration, find at least one point in space where the magnetic field is zero.

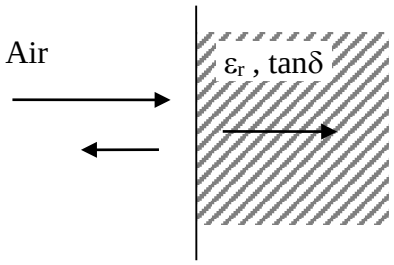


Problem 3 - A plane wave at 15 GHz and having a magnetic field of 20 mA/m is normally incident on a medium with $\varepsilon_r = 3$, $\tan\delta = 1$. Find

a) the total electric field at the interface (in magnitude);

b) the power density at 3 cm from the interface in medium 2;

d) the distance from the interface at which the power density is reduced by a factor of 10.



Problem 4 - A 200 MHz frequency source having 50 W available power and 50 Ω internal impedance is connected to a load Z_L by a 50 Ω characteristic impedance transmission line. The line length is 15 m and the load is the series connection of a 100 Ω resistor and a capacitor of 10 pF. The attenuation on the line is 50 dB/km.
Find

a) The power absorbed by the load;
b) The power lost on the line.