Electrical and Computer Engineering
ECE3712 Electromagnetic Fields and Waves

Matlab Project on Electrostatics

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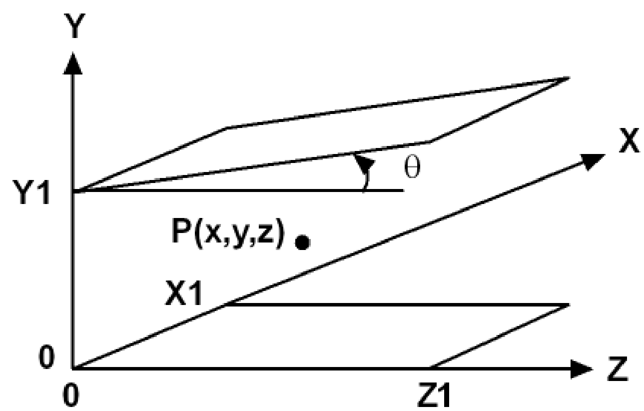
A first metal plate is oriented in the X-Z plane with Y = 0 and has sides Z1 and X1 as shown. The surface area S_1 = X1(Z1). The uniform surface charge density for the first plate ρ_S = +0.1 C/cm^2

A second metal plate is oriented as shown with the left side at Y1 but tilted at an angle θ with respect to the X-Z plane. For this second plate the width in the X direction is also X1 and the right end is at Y = Y1 + Z1 tan(θ). The surface area S_2 = X1(Z1$\sqrt{(1+\tan^2\theta)}$). The uniform surface charge density for the second plate ρ_S = + 0.4 C/cm^2



Using the discrete summation solution in MATLAB of the integral form of Coulomb's Law with discrete charges ΔQ from the surface charge density ρ_S and surface area ΔS, determine the resulting **E** at a point P(x,y,z) as shown.

$$\mathbf{E} = \int \frac{dQ}{4\pi\,\varepsilon_o\,R^2}\,\mathbf{a_R}$$

$$\mathbf{E} = \sum \frac{\Delta Q}{4\pi\,\varepsilon_o\,R^2}\,\mathbf{a_R} = \sum \frac{\rho_S \Delta S}{4\pi\,\varepsilon_o\,R^2}\,\mathbf{a_R}$$

The point P(x,y,z) should be entered as a variable for x, y, and z should range from:

$0.2(X1) \leq x \leq 0.7(X1) \quad 0.2(Z1) \leq z \leq 0.7(Z1) \quad 0.2(Y1) \leq y \leq 0.7(Y1)$

Out of range entries should be *flagged.* This is to avoid the electrostatic field anomaly and calculation difficulty due to the *fringing effect*. You are to reference and discuss in the Report what is meant by the *fringing effect*.

For the distances X1 and Z1 use your birth date in cm and birth month in cm with the smaller (or equal) number as X1 and the larger (or equal) number as Z1. For the distance Y1 = (X1 + Z1)/2. For example, June 16th means X1 = 6 cm, Z1 = 16 cm and Y1 = 11 cm.

The angle θ in degrees is your birth year minus 1985 x 2. If the year is 1995 then $\theta = 20^{o}$

You should use a value for ΔS that can approximate the integral formulation for **E** from the discrete summation. To show this you are to compare a ΔS = 0.1 x 0.1 cm (1 x 1 mm) solution to that obtained for 0.01 x 0.01 cm (0.1 x 0.1 mm) and 0.001 x 0.001 cm (10 μm x 10 μm) for the resultant **E**.

Note that $S_1 \neq S_2$ which implies that the number of discrete summation is different for each of the surfaces. The resulting **E** is the sum of $\mathbf{E_1}$ from S_1 and $\mathbf{E_2}$ from S_2.

Plot you results for the resulting **E** in Cartesian coordinates. Plot the results for **E** for: *1.* x as a variable and y = Y1/2 and z = Z1/2 fixed; and *2*. z as a variable and y= Y1/2 and x = X1/2.

Queries and concerns for you project, especially if there are unreasonable parameters, should be directed to the Instructor in a timely manner.

This project is to be written using the *Project Report Format* and hard copy is due no later than 3 PM Friday October 20, 2017 in class. Late submission can be done via email to the Instructor for time and date stamping but with hard copy immediately afterwards. Late submission will result in a grade reduction of one-half a letter grade per day.

This project is an example of an electrostatic deflection plate where the resulting **E** is used to deflect moving electrons (the Lorentz force).