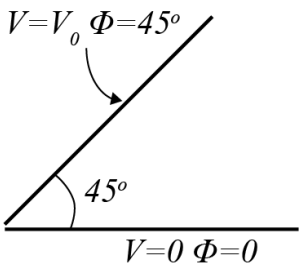
EE2010: Engineering Electromagnetics

Homework Assignment 3 **Deadline: Fri, 23rd Aug, 2 PM**

1. Consider a wedge capacitor with two infinite conducting plates at an angle $\Phi = 45^o$. The structure is invariant in the z direction (into the paper), and there exists an insulating gap between the plates.



   (a) Determine the potential between the plates by writing the general solution to Laplace equation, and then applying the boundary conditions.

   (b) Determine the surface charge density on the conductor at $\Phi = 0^o$

2. Problem 1 can also be solved using the 'averaging property' of potentials which satisfy Laplace equation. Answer the questions below:

   (a) Using the numerical procedure discussed in class obtain the numerical solution for problem 1 above assuming $V_0 = 1\ V$. How many iterations are necessary to obtain 'reasonable' convergence?

   (b) Plot the potential along the line $\Phi = 22.5^o$ in the form of a line graph (choose 'sufficiently fine' grid). Compare this numerical result with the analytical solution obtained in problem 1.

   (c) Submit the numerical code used to obtain the results. *You are strongly encouraged (not mandatory!) to use Python to perform the coding required in this assignment. Anaconda distribution and Spyder IDE are a good starting point if you are unfamiliar with Python. Numpy and Matplotlib packages may be useful for matrix manipulation and plotting respectively.*

3. A point charge q is situated a distance a from the center of a grounded conducting sphere of radius R. Find the potential outside the sphere using method of images.

4. Do the functions (i) $x^2 + y^2$, and (ii) $x^2 - y^2$ satisfy the Laplace equation? Verify that the solutions of Laplace equation exhibit maxima and minima only at the boundaries (no local maxima or minima) by plotting these functions as a 3D surface plot. Explain.

5. **Reading Assignment** Review the following

   (a) Averaging and uniqueness theorems - sections 3.1.4-3.1.6

   (b) Method of images - section 3.2.1

   (c) Problems discussed in class (problem numbers provided in lecture slides)