Fields and Waves
March 11th, 2016

1. Two perfect dielectrics have relative permittivities ε_{r1}= 3 and ε_{r2} = 6 . The planar interface between them is the surface *x* +*y* +2*z* =1. The origin lies in region 1. If $\overrightarrow{E_1}$= 24 $\widehat{a_x}$ +36 $\widehat{a_y}$ +42 $\widehat{a_z}$ V/m, find $\overrightarrow{E_2}$. Write a MATLAB program to determine the field $\overrightarrow{E_2}$ for arbitrary values of the permittivities $\overrightarrow{E_1}$, ε_{r1} and ε_{r2} .

2.

   (a) The electric flux density is given as $\vec{D}$=(x^3) $\widehat{a_x}$ + (x^2y) $\widehat{a_z}$. Write a MATLAB program to determine the charge density inside a cube of side 2m placed centered at the origin with its sides along the coordinates axes.

   (b) The electric flux density is given by $\vec{D}$=($\frac{100\cos(2\theta)}{r}\hat{\theta}$) C/m^2. Write a MATLAB program to determine the charge enclosed within the region 1 < r < 2 , 0 < Θ < $\frac{\Pi}{2}$ rad.

3. Just inside the surface of a dielectric slab the electric field is 10 V/m and makes an angle of 60^0 with the surface . If the dielectric constant of the slab is 4, Write a MATLAB program to determine the the electric field and its direction just above the surface.

4. Two grounded semi infinite metallic plates are placed on the y-axis and the z-axis of a Cartesian coordinate system in order to form a 90° corner. A positive charge $4\pi\varepsilon_0$ is located at the point (a, a) where a is arbitrary. Using MATLAB, carefully plot equipotential contours surrounding this charge and the expected electric field.

5. A two-dimensional potential distribution can be approximated with the quadratic expression:

$$V = -\frac{\rho_v}{4\varepsilon_0}(x^2 + y^2)$$

   Show that this function satisfies Poisson's equation. Plot the graphs of the charge and the electric potential distribution.