Homework assignment 5

5.1.0.

Using Eq. (5.1), $\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$, and Eq (5.2), (5.7), derive Eq. (5.8), page 130, Giodano and Nakanishi (2nd edition):

$$V(i,j,k) = \frac{1}{6}[V(i+1,j,k) + V(i-1,j,k) + V(i,j+1,k) + V(i,j-1,k) + V(i,j,k+1) + V(i,j,k-1)]$$

5.1.1

Figure 5.4. It is an infinitely long, hollow prism, with metallic walls and a square cross-section. Inside this prism is a metal bar, also with a square cross-section. We assume that a voltage is applied between the bar and the outer walls, and we want to calculate the potential in the space between them. show the equipotential contoursand the corresponding electric field

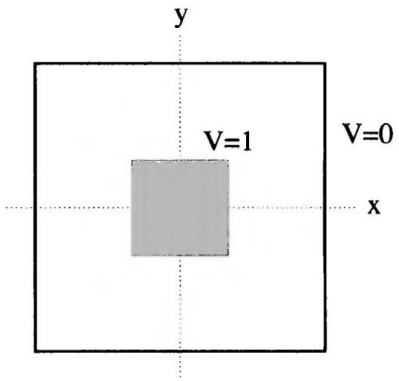

Figure 5.4: Schematic cross section of a hollow metallic prism with a solid, metallic inner conductor. The prism and inner conductor are presumed to be infinite in extent along z. The inner conductor is held at $V = 1$ and the walls of the prism at $V = 0$.

5.1.2. **Electric potential and field near near two capacitor plates. The plates were held at $V = +1$ (left plate) and $V = -1$ (right plate), while the square boundary surrounding the plates was held at $V = 0$. The plates are located at $x = \pm 0.3$ and the spatial step size was 0.1. For simplicity the box and plates were assumed to be infinite in extent along the z direction.** :

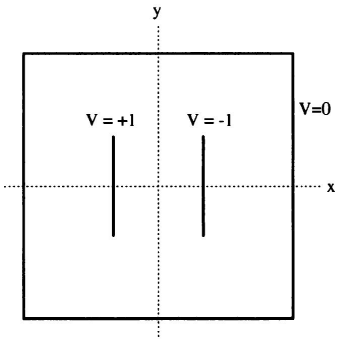

Figure 5.6: Schematic of two capacitor plates held at $V = 1$ (left plate) and $V = -1$ (right plate). The square boundary surrounding the plates is held at $V = 0$.

Obtain the (i) equipotential lines using 2D contourplot, (ii) perspective plot of the potential [i.e., 3D plot of $V(x,y)$ as a function of $\{x,y\}$, using ListPlot3D command], and (ii) the electric fields in a 2D vector plot.

5.1.1

Extend our treatment of a point charge in a metal box to deal with the case in which the charge is located near one face of the box. Study how the equipotential contours are affected by the proximity of a grounded surface (the face of the box).

5.13 Calculate the value of π by using numerical integration to estimate the area of a circle of unit radius. Observe how your estimate approaches the exact value (3.1415926 . . .) as the grid size in the integration is reduced.