



ECE5340/6340: Homework 1

Write your section (ECE5340 or ECE6340) by your name. Turn in a printed copy containing the problem solutions, plots, and the code used to generate them. Remember to comment and format the code so is legible to the graders. Label the plots appropriately, including units for each axis and for the values plotted. Assume all units to be SI units unless stated differently. Due Wednesday 1/18 BEFORE class begin.

Problem 1

Consider a two-dimensional space containing the following point electric charges (all position values are given in *cm*):

	Charge	X position	Y position
q_1	-1 nC	7	21
q_2	2 nC	15	25
q_3	-5 nC	19	8
q_4	3 nC	9	8

- [10points] Draw or plot a diagram of the location of the charges and the region to plot.
- [40points] Calculate and plot the \vec{E} field (magnitude and direction) present in the region delimited by $10 < x < 20$ and $10 < y < 20$ due to the presence of the electric charges above, considering that the electric field at a point p due to the presence of a single charge is given by

$$\vec{E}_p = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}$$

\vec{E} field magnitude can be plotted as a color plot and \vec{E} field direction can be plotted using a quiver plot. These plots can be overlapped in one figure or on two different figures.

- [10points] If all electric charges other than q_4 are removed, can you explain what would happen if you were to compute the total \vec{E} field at position $x = 9, y = 8$ using the expression given? Why does this happen?

Problem 2

Consider an electric field defined as

$$\vec{E} = \sin\left(\frac{\pi}{2}y\right)\hat{i} - \sin\left(\frac{\pi}{2}x\right)\hat{j}$$

in the region delimited by $-1 < x < 1$ and $-1 < y < 1$.

1. [15points] Plot the \vec{E} field in the region, using the same kind of plot(s) as in Problem 1.
2. [10points] Calculate $\nabla \cdot \vec{E}$.
3. [15points] Would you say that there are zones with a net electric charge (positive or negative) somewhere inside the region? Where? Why do you think so?