PEP542 Homework
Spring 2025

Instructor: Dr. Chunlei Qu (cqu5@stevens.edu)

February 16, 2025

- There could be typos, please let me know if you find any issues.
- Do not copy solutions from Google or other online resources. It is very easy to tell whether the solution is original work or not.
- You are encouraged to discuss the problems with the other students.
- Please scan your solutions (make sure that the solution is recognizable) and upload the PDF file to Canvas.
- Late homework will not be counted in the final grade.
- Each student is granted one late-homework exemption, provided the homework is submitted within five days of the deadline. Please use it wisely.

Homework 3 (Due 2pm, Feb 21)

1. Find the electric field (magnitude and direction) a distance z above the midpoint between equal and opposite charges ($\pm q$), a distance d apart.
2. Find the electric field a distance z above the center of a flat circular disk of radius R that carries a uniform surface charge σ. What does your formula give in the limit $R \to \infty$? Also check the case $z \gg R$.
3. Suppose the electric field in some region is found to be $\mathbf{E} = kr^3\hat{r}$, in spherical coordinates (k is some constant).

(a) Find the charge density ρ.

(b) Find the total charge contained in a sphere of radius R, centered at the origin. (Do it two different ways. Hint: Gauss's law in integration and differential forms.)

4. Use Gauss's law to find the electric field inside and outside a **spherical shell** of radius R that carries a uniform surface charge density σ.
5. A long coaxial cable carries a uniform **volume** charge density ρ on the inner cylinder (radius a), and a uniform **surface** charge density on the outer cylindrical shell (radius b). This surface charge is negative and is of just the right magnitude that the cable as a whole is electrically neutral. Find the electric field in each of the three regions:

(i) inside the inner cylinder ($s < a$),

(ii) between the cylinders ($a < s < b$),

(iii) outside the cable ($s > b$).

Plot $|\mathbf{E}|$ as a function of s.