

PHYN211 – Project #1

Write a report on the following two problems. The report should include **results**, **comments on the results**, and **MATLAB code**.

Project Deadline: 31/03/2023

Disclaimer: ANY SORT OF CHEATING WON'T BE TOLERATED.

Problem #1:

A finite cylinder of length ' $2L$ ' and radius ' a ', has a uniform surface charge density ' ρ_{so} '. It has its axis along the z direction. It's centered about the $z = 0$ plane.

Using MATLAB,

1. Perform **numerical integration** to find the **electric field** at a point on the z -axis **outside** the cylinder at $(0,0,h)$. Use different steps ' n ' for integration (i.e., $n = 3, 9, 15, 30, 50, 100$).
2. Plot the **electric field magnitude** vs the z -axis where $|z| > L$.
3. Treat the cylinder as an infinite cylinder (take the potential at $\rho = 30L$ to be zero),
 - a. Using **symbolic integration** in MATLAB, find an expression for the **electric potential** outside the cylinder.
 - b. Plot the **electric field magnitude** vs radius (inside and outside the cylinder).
 - c. Plot the **electric field lines** in xy -plane and show the **electric field arrows**.
 - d. Plot the **electric potential** in xy -plane.

Groups 1-3:

Quantity	Value
L	5 m
a	0.5 m
ρ_{so}	$20 \mu\text{C}/\text{m}^2$
h	15 m

Groups 4-6:

Quantity	Value
L	3 m
a	0.2 m
ρ_{so}	$10 \mu\text{C}/\text{m}^2$
h	10 m

Groups 7-9:

Quantity	Value
L	4 m
a	0.4 m
ρ_{so}	$30 \mu\text{C}/\text{m}^2$
h	12 m

Groups 10-11:

Quantity	Value
L	6 m
a	0.6 m
ρ_{so}	$50 \mu\text{C}/\text{m}^2$
h	20 m

Problem #2:

Groups 1-6:

Two solid spheres of radii $a = 0.5$ m and $b = 0.7$ m are charged with charge densities of $\rho_{v1} = 5 \mu\text{C}/\text{m}^3$ and $\rho_{v2} = 10 \mu\text{C}/\text{m}^3$, respectively. The first sphere is located at (0,5,0), and the second sphere is located at (10,0,0).

Using MATLAB,

1. Find the point(s) where the **electric field** is **maximum**.
2. Find the point(s) where the **electric field** **vanish**.
3. Plot the **electric field lines** in the xy-plane and show the **electric field arrows**.
4. Plot the **electric potential** in xy-plane.

Groups 7-11:

Two hollow spheres of inner radius $a = 0.3$ m and outer radius $b = 0.6$ m are charged with charge densities $\rho_{v1} = -15 \mu\text{C}/\text{m}^3$ and $\rho_{v2} = -15 \mu\text{C}/\text{m}^3$. The first one is located at (0,3,3), while the other is at the origin.

Using MATLAB,

1. Find the point(s) where the **electric field** is **maximum**.
2. Plot the **electric field** and **potential** vs the radius (inside and outside the sphere).
3. Plot the **electric field lines** in the xy-plane and show the **electric field arrows**.
4. Plot the **electric potential** in xy-plane.