University of Tlemcen
Faculty of Sciences
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1st year LMD-M and MI

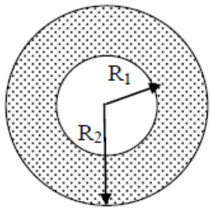
SW N° 02 Gauss's theorem

Exercise 1:

Let be two concentric spheres with center O and radius R_1, R_2 such that $R_1<R_2$. The sphere of radius R_1 is volume-charged with a constant volume charge **density ρ**. The second of radius R_2 is surface-charged with a constant surface charge **density σ**.

1- Using Gauss's theorem find the expression for the electrostatic field E(r) at any point in space.
2- Deduce the expression of the electric potential V(r) at any point in space.
3- Plot the curves of E(r) and V(r).

Exercise 2:



Let be two concentric spheres of center O of radius R_1 and R_2 respectively such that $R_1<R_2$. Using GAUSS' theorem:
1- Calculate the electrostatic field at any point in space for a volume distribution of charges uniformly distributed between these two spheres.
2- Deduce the electric potential at any point in space.

Exercise 3:

A cylinder of infinite height and radius R is surface-charged with a constant surface charge **density σ**. On the axis of this cylinder we place a conducting wire of infinite length and constant linear charge **density λ**.
1- Write the expression for the electric flux through the Gauss surface.
2- Calculate, at any point in space, the electrostatic field E(r) created by this distribution of charges.
3- Deduce the expression of λ so that the field outside the cylinder is zero.

Exercise 4:

Consider two infinitely long coaxial cylinders of radius R_1 and R_2 such that $R_1<R_2$. The first of radius R_1, charged with surface **density $+\sigma$**; and the second of radius R_2, charged with surface **density $-\sigma$.**
1- Calculate the electrostatic field at any point in space, Plot the graphs E(r) as a function of r.
2- Deduce the electrostatic potential.

Supplementary exercises :

Exercise 1:

Using Gauss's theorem, calculate the electrostatic field at any point in space for a volumetric distribution of charge uniformly distributed **between two coaxial cylinders** of infinite lengths and radius R_1, R_2 respectively such that $R_1<R_2$. Deduce the potential at any point in space.

Exercise 2 :

A sphere of center O and radius R charged in volume with **a variable** volume charge density **$\rho = A/r$ positive**.

1- Applying GAUSS' theorem, calculate the electric field at any point in space.
2- Deduce the electric potential at any point in space.
3- Plot the graphs E(r) and V(r) as a function of r.