ElecEng 2FL3
Assignment 7
Generating Field Plots

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Assignment 7 is derived and extended from the Examples and the Exercises in Set 5 and Set 10 of "Electromagnetics I: MATLAB Experiments Manual for EE2FH3" by Dr. M.H. Bakr and Chen He. This Manual is freely available for download from A2L course page. It is recommended that, before you start working on this assignment, you study the Examples in Set 5 and Set 10 of the Manual. It will teach you how to use MATLAB® to generate plots of vector-field distributions and equipotential lines.

1 Instructions

This Assignment does not require an analytical solution, i.e., derivations or proofs. However, it does require that you state the analytical expressions for the **E**-field and the potential V as functions of space. These analytical expressions will depend on which version of the Assignment applies to you. These expressions can be found in the lecture notes or in your textbook.

You will program these analytical expressions in your MATLAB codes in order to generate the respective field plots. The analytical expressions for the **E**-field and the potential V as functions of space (relevant to your version of the assignment) must be clearly stated in written or printed form and must be submitted through the A2L course website in PDF file format. Ensure that the appropriate units and vectors are stated correctly.

Then, a MATLAB® code must be written that generates the field plots by making use of the analytical field expressions evaluated at the grid points of the plot. You must submit your MATLAB® (*.m) file through the A2L course website.

2 Problem Statement

The assignment consists of two parts. Solve either **VERSION A** or **VERSION B** as described below (**see section 3** for the variation applying to you):

- **VERSION A**: A very long coaxial structure (cable) has an inner radius of ρ_1 and an outer radius of ρ_2. Its axis is along z. It is filled with vacuum. The inner conductor has a surface charge density of $\rho_s = 3$ nC/m^2. Figure 8.1 in Set 8 of the MATLAB® Manual provides an example of a coaxial structure.

  1. Using the analytical expression, generate a MATLAB® *quiver* plot of the electric field vector $\mathbf{E}(\rho)$ in the region $\rho_1 \leq \rho \leq \rho_2$, $0 \leq \phi \leq 2\pi$, and $z = 0$. The plot should be a 2-dimensional (2-D) slice in the cable's cross-section.
  2. Using the analytical expression for the potential V(ρ), generate a MATLAB® *contour* plot of the equipotential lines in the same 2-D region as part 1.

- **VERSION B**: A spherical capacitor is made of an inner spherical conductor of radius r_1 and an outer spherical conductor of radius r_2. In between the two conductors exists vacuum. The inner conductor has a surface charge density of $\rho_s = 4$ nC/m^2.

  1. Using the analytical expression, generate a MATLAB® *quiver* plot of the electric field vector $\mathbf{E}$(r) in the region $r_1 \leq r \leq r_2$, $\theta = \pi/2$, and $0 \leq \phi \leq 2\pi$. The plot should represent a 2-dimensional (2-D) slice of the structure in the plane $z = 0$.
  2. Using the analytical expression for the potential V(r), generate a MATLAB® *contour* plot of the equipotential lines in the same 2-D region as part 1.

In both versions, for full marks, ensure that

- both plots are overlayed on the same figure;
- no less than five equipotential lines are included;
- the plots are clear to understand, with no overlaying text or field lines.

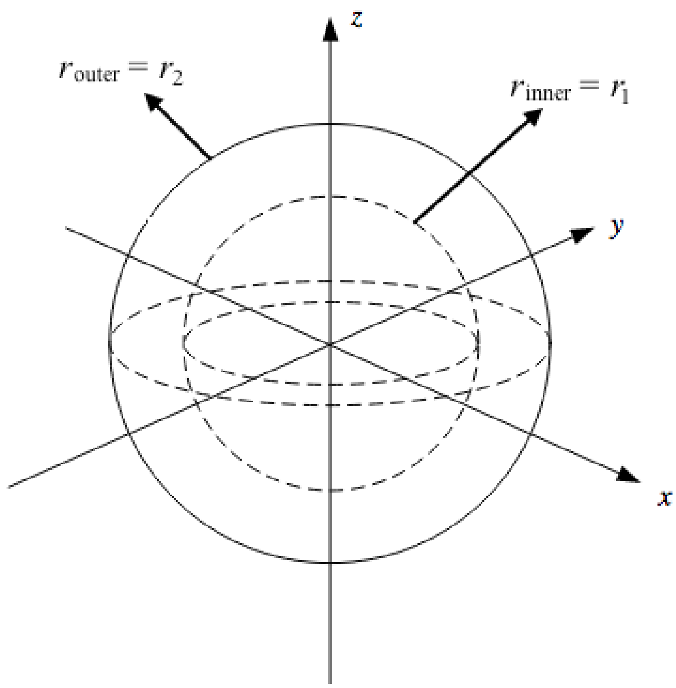

Figure 1: Image of a spherical capacitor for **VERSION B**.

3 Variations

Find your assigned variation number (#) from the last (rightmost) digit of your student number. Your assigned variation number also determines which version of the problem statement you are to complete.

VERSION A

#	ρ_1 (metres)	ρ_2 (metres)
0	0.01	0.02
1	0.02	0.04
2	0.03	0.06
3	0.04	0.08
4	0.05	0.10

VERSION B

#	r_1 (metres)	r_2 (metres)
5	0.01	0.02
6	0.02	0.04
7	0.03	0.06
8	0.04	0.08
9	0.05	0.10

Table 1: Assigned variations