ElecEng 2FL3
Assignment 6
E Field Superposition

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Assignment 6 is derived and extended from the Examples and Exercises of Sets 3 and 4 of "Electromagnetics I: MATLAB Experiments Manual for EE2FH3" by Dr. M.H. Bakr and Chen He. This Manual is freely available for download from the A2L course page. It is recommended that, before you start working on this assignment, you study the Examples in Sets 3 and 4 of the Manual. They will teach you how to use MATLAB® to perform line and surface integration of vector-field quantities using a discretization approach. Such integration is the numerical implementation of the vector superposition principle.

1 Instructions

By completing this exercise you will gain experience using The Mathworks® MATLAB® software. You must first solve the assigned problem *analytically*. This analytical solution must be submitted through the A2L course website in PDF file format. The solution can be either handwritten or typed.

Then, a MATLAB® code must be written that solves the same problem. Note that your code must employ a discretization of the line or the surface charge into line and surface elements, respectively. You *must not* employ the analytical integration functionality of MATLAB® since the purpose here is to teach you how to implement discretization in a numerical code. If your code works correctly, the answers should be the same as your analytical solution to within a small error margin. You must submit your MATLAB® (***.m) file through the A2L course website.

2 Problem Statement

Solve **either** version (a) **or** version (b) as described below (**see section 3** for the variation applying to you):

(a) A finite uniform linear charge $\rho_L = 4$ nC/m lies in the $z = 0$ plane. For an example plot, see Figure 3.4 on p. 20 of the MATLAB® Manual. The coordinates of the two ends of the line charge, A and B, are given in Table 1. Find **E** at (0, 0 ,0).

(b) Given the flat ring of surface charge density $\rho_s = 2.0$ μC/m^2 existing in the region $\rho_1 \leq \rho \leq \rho_2$ m, $0 \leq \phi \leq 2\pi$ deg, $z = 0$ m, and zero elsewhere, find **E** at $P(\rho = 0$ m, $z = 1$ m$)$. The values of ρ_1 and ρ_2 are given in Table 2. For an example plot, refer to Figure 4.6 on p. 27 in the MATLAB® Manual. In this figure, you will observe a disk, which is the same as a ring described by $0 \leq \rho \leq \rho_2$ m, $0 \leq \phi \leq 2\pi$ rad, $z = 0$ m.

3 Variations

Find out your assigned variation number (#) from the last (rightmost) digit of your student number, which must match the number of the variation found in the tables below.

#	A (m)	B (m)
0	5, 0, 0	0, 5, 0
1	-5, 0, 0	0, -5, 0
2	5, 0, 0	0,- 5, 0
3	-5, 0, 0	0, 5, 0

Table 1: Assigned variations of the Cartesian coordinates of the begin and end points (A and B) of the line charge. Applicable to students whose student numbers end in a digit ranging from 0 to 3.

#	ρ_1 (m)	ρ_2 (m)
4	0.0	0.1
5	0.1	0.2
6	0.2	0.3
7	0.3	0.4
8	0.4	0.5
9	0.5	0.6

Table 2: Assigned variations of the cylindrical coordinate limits associated with the flat ring charge. Applicable to students whose student numbers end in a digit ranging from 4 to 9.