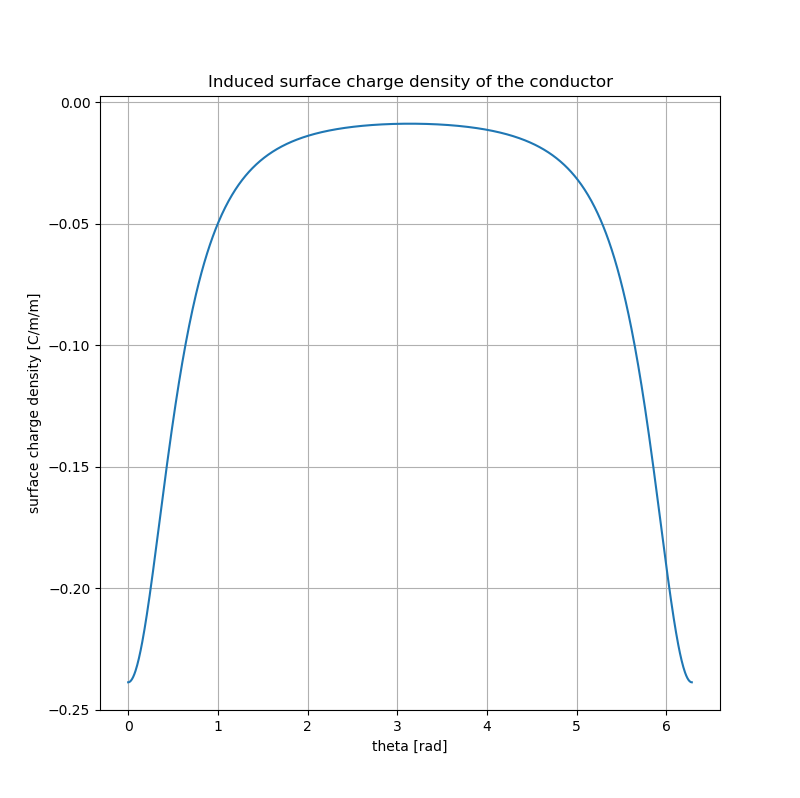
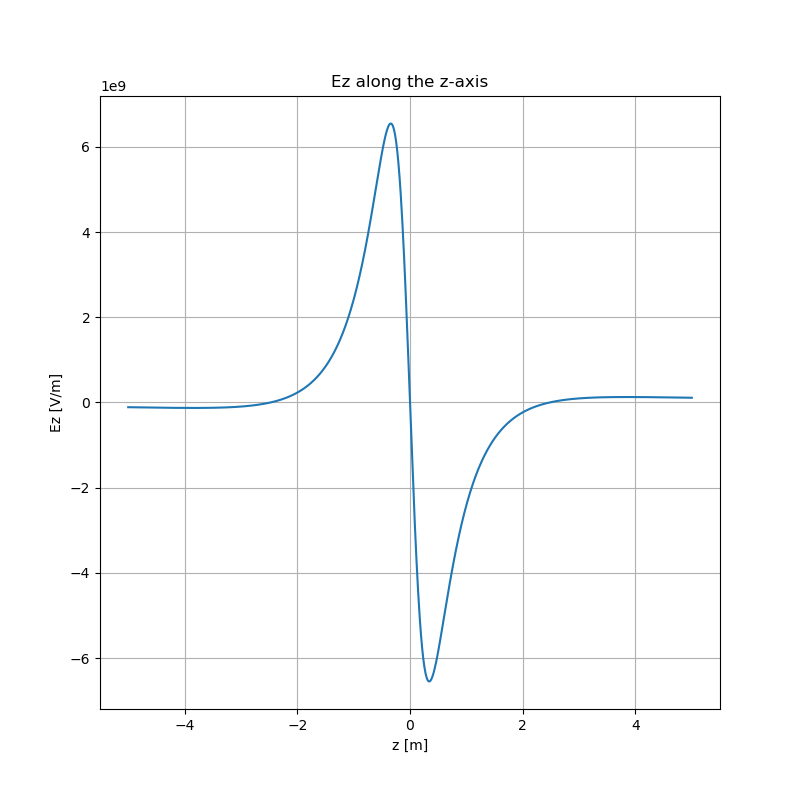
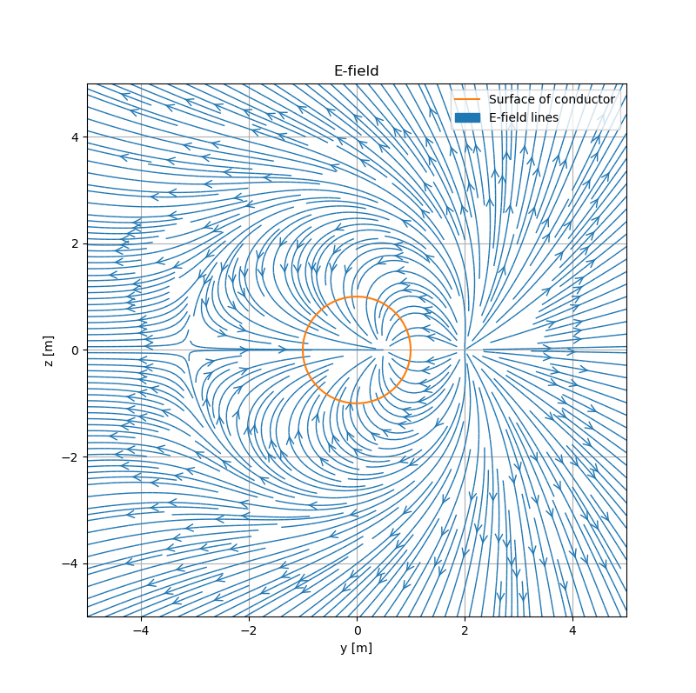
Phys 301 Assignment 5 Nicholas Pun

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Q1. a), b) and c) respectively:



The code is as follows:

# -\*- coding: utf-8 -\*-

"""

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@author: Nick

"""

import numpy as np

import matplotlib.pyplot as plt

# Constants

eps0 = 8.854e-12

k = 1/(4\*np.pi\*eps0)

# Variables

a = 1

d = 2\*a

b = a\*\*3/d

q1 = 1

q2 = -q1\*a/d

# Grid of y, z points

L=5\*a

ny, nz = 1000, 1000

y = np.linspace(-L, L, ny)

z = np.linspace(-L, L, nz)

Y, Z = np.meshgrid(y,z)

# Electric Field

Ey = k\*(q1\*(-d+Y)\*((-d+Y)\*\*2+Z\*\*2)\*\*(-3/2) - q2\*(b-Y)\*((b-Y)\*\*2+Z\*\*2)\*\*(-3/2))

Ez = k\*(q1\*Z\*((-d+Y)\*\*2+Z\*\*2)\*\*(-3/2) + q2\*Z\*((b-Y)\*\*2+Z\*\*2)\*\*(-3/2))

# Create circle for surface of sphere

theta = np.linspace(0,2\*np.pi,1000)

y1 = a\*np.cos(theta)

z1 = a\*np.sin(theta)

# Plot E-field

plt.figure(figsize = (8,8))

plt.streamplot(y, z, Ey, Ez, linewidth=1, density=3, arrowstyle='->', arrowsize=1.5);

plt.plot(y1,z1)

plt.xlabel('y [m]')

plt.ylabel('z [m]')

plt.title('E-field')

plt.legend(['Surface of conductor','E-field lines'])

plt.grid()

# Calculate Ez along z-axis

Ez1 = k\*(q1\*z\*((-d)\*\*2+z\*\*2)\*\*(-3/2) + q2\*z\*((b)\*\*2+z\*\*2)\*\*(-3/2))

# Plot Ez

plt.figure(figsize = (8,8))

plt.plot(z,Ez1)

plt.xlabel('z [m]')

plt.ylabel('Ez [V/m]')

plt.title('Ez along the z-axis')

plt.grid()

# Calculate surface charge

sigma = eps0\*k\*(q1\*(a-d\*np.cos(theta))\*(a\*\*2+d\*\*2-2\*a\*d\*np.cos(theta))\*\*(-3/2)

+ q2\*(a-b\*np.cos(theta))\*(a\*\*2+b\*\*2-2\*a\*b\*np.cos(theta))\*\*(-3/2))

# Plot surface charge

plt.figure(figsize = (8,8))

plt.plot(theta,sigma)

plt.xlabel('theta [rad]')

plt.ylabel('surface charge density [C/m/m]')

plt.title('Induced surface charge density of the conductor')

plt.grid()