EEL3470: Electromagnetic Fields **10/7/2020**

Midterm Exam

(9:00 to 11:30 AM)

Problem 1 (14 pts)

Given the following two vectors $\boldsymbol{A} = -2\mathbf{a}_x + 6\mathbf{a}_y + 5\mathbf{a}_z$ and $\boldsymbol{B} = \mathbf{a}_x + 2\mathbf{a}_y + 3\mathbf{a}_z$ in meters, find

a) $\boldsymbol{A} \times \boldsymbol{B}$
b) The angle between the two vectors in degrees.
c) The scalar projection of $\boldsymbol{A}$ on $\boldsymbol{B}$.

Problem 2 (14 pts)

In free space, there is a point charge Q = 8 nC at (-2 m, 0, 0), an infinite line charge ρ_L = 10 nC/m that passes through the point (2 m, 2 m, 0) parallel to the z-axis, and a sheet charge ρ_s = 12 nC/m^2 at y = -2 m. Illustrate the problem graphically and determine $\boldsymbol{E}$ at the origin.

Problem 3 (14 pts)

The electric flux density is given by $\boldsymbol{D} = 2\rho(z+1)\cos\phi\,\boldsymbol{a}_\rho - \rho(z+1)\sin\phi\,\boldsymbol{a}_\phi + \rho^2\cos\phi\,\boldsymbol{a}_z$ μC/m^2

a) Find the volume charge density.
b) Calculate the total charge enclosed by the volume $0 < \rho < 2$ m, $0 < \phi < \pi/2$, $0 < z < 4$m
c) Calculate the outward flux passing through the surface S_1 where $\phi = 0$.

Problem 4 (14 pts)

A volume charge density, $\rho_v = 10\,r$ C/cm^3 is distributed inside a spherical shell of inner radius "a" and outer radius "b" where $a \le r \le b$. Use Gauss's law to determine the electric field intensity vector every where as a function of the radial distance r.

Problem 5 (14 pts)

In free space, the potential field is given by $V = \dfrac{10}{r^2}\sin\theta\cos\varphi$, find:

a) The electric flux density at (2 m, 90˚, 0)
b) The work done to move a 10 μC from point A = (1 m, 30˚, 120˚) to point B = (4 m, 90˚, 60˚).

---------- **End of Exam** ----------