PROBLEM SESSION II

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
Electrical Engineering Department
EE 340: Introduction to Electromagnetics

Problem 1.a) Find the surface integral of \( \mathbf{F} = 5 \mathbf{a}_r \) over \( S \), where \( S \) is a cubical surface 3 units of length of the side with a corner at the origin. One of the faces of the cube lies in the first quadrant of the \( x-y \) plane. (b) Repeat (a) for \( \mathbf{F} = x^2 y^2 \mathbf{a}_x \).

Problem 2.a) Evaluate the surface integral of \( \mathbf{F} = \frac{\mathbf{a}_r}{r^2} \) over the spherical surface of radius 4 centered at the origin. (b) Repeat part (a) for \( \mathbf{F} = \frac{\sin^2 \phi}{r^2} \mathbf{a}_r + \cos \phi \mathbf{a}_\theta \). (c) Repeat part (a) for \( \mathbf{F} = \mathbf{a}_x \).

Problem 3. Consider the conical surface \( S \) shown in figure 2. The cone has height \( h \) and base radius \( a \). Evaluate the closed surface integral of the following vector fields: (a) \( \mathbf{F} = r \mathbf{a}_r \). (b) \( \mathbf{F} = r \mathbf{a}_\theta \). (c) \( \mathbf{F} = \cos \phi \mathbf{a}_\phi + r \mathbf{a}_\theta \).

Problem 4. Consider the closed cylindrical surface of height \( h \) and base radius \( a \) as shown in figure 3. Evaluate the closed surface integral of \( \mathbf{F} \) over this surface if: (a) \( \mathbf{F} = \rho^2 \mathbf{a}_\rho + \rho \sin \phi \mathbf{a}_\phi + \rho^2 \sin \phi \mathbf{a}_z \). (b) \( \mathbf{F} = x \mathbf{a}_x + z \mathbf{a}_z \).

![Figure 1: The surface for Problem 3](image1.png)

![Figure 1: The surface for Problem 4](image2.png)