King Fahd University of Petroleum and Minerals

Electrical Engineering Department

PROBLEM SESSION # 2

Problem 1.a) Find the surface integral of $\boldsymbol{F} = 5\, \boldsymbol{a}_y$ 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 $\boldsymbol{F} = x^2 y^2\, \boldsymbol{a}_x$.

Problem 2.a) Evaluate the surface integral of $\boldsymbol{F} = \dfrac{a_r}{r^2}$ over the spherical surface of radius 4 centered at the origin. **(b)** Repeat part (a) for $\boldsymbol{F} = \dfrac{\sin^2 \phi}{r^2} a_r + \cos\phi\, a_\theta$. **(c)** Repeat part (a) for $\boldsymbol{F} = \boldsymbol{a}_x$.

Problem 3. Consider the conical surface S shown in figure 1.
The cone has height h and base radius a. Evaluate the closed surface integral of the following vector fields: **(a)** $\boldsymbol{F} = r\, \boldsymbol{a}_r$. **(b)** $\boldsymbol{F} = r\, \boldsymbol{a}_\theta$. **(c)** $\boldsymbol{F} = \cos\phi\, \boldsymbol{a}_\phi + r\, \boldsymbol{a}_\theta$.

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

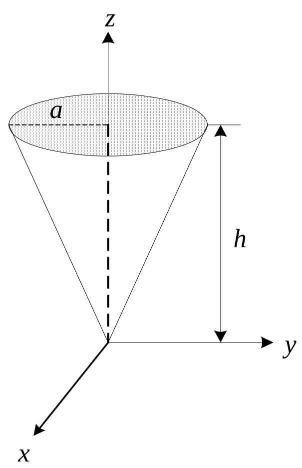

Figure 1: The surface for problem 3

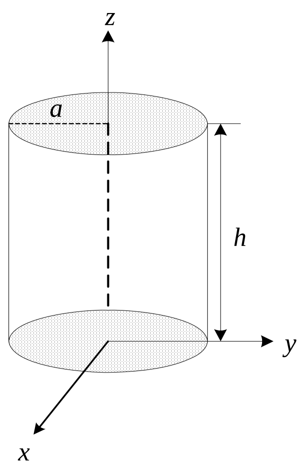

Figure 2: The surface for problem 4