## King Fahd University of Petroleum and Minerals Electrical Engineering Department

## **PROBLEM SESSION # 2**

**Problem 1.a**) Find the surface integral of  $F = 5 a_y$  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  $F = x^2 y^2 a_x$ .

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

**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)  $F = r a_r$ . (b)  $F = r a_{\theta}$ . (c)  $F = \cos \phi a_{\phi} + r a_{\theta}$ .

**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 *F* over this surface if: (a)  $F = \rho^2 a_{\rho} + \rho \sin \phi a_{\phi} + \rho^2 \sin \phi a_z$ . (b)  $F = x a_x + z a_z$ .



Figure 1: The surface for problem 3

Figure 2: The surface for problem 4