

**Engineering 6813    Tutorial 1 (Review of Electrostatics)    Fall, 2009**

1. The potential at a certain point in free space is given by

$$V = \frac{(50\rho^2 \cos \phi)}{(z + 1)} \text{ V}$$

At the point  $P(4, \frac{\pi}{6}, 2)$  determine (a) the electric flux density; (b) the charge density; (c) the value of the Laplacian; and (d) a unit normal,  $\hat{n}$ , to the  $V$  surface in the direction of decreasing  $V$ .

2. The displacement flux density in a region of free space specified by  $0 \leq x \leq 1$ ,  $0 \leq y \leq 2$ ,  $0 \leq z \leq 3$  is given as  $\vec{D} = 2xy\hat{x} + x^2\hat{y}$  C/m<sup>2</sup>. Verify the divergence theorem for this case and determine the charge within the region.

3. An electric field intensity in V/m is given by

$$\vec{E} = y\hat{x} + x\hat{y} + 6\hat{z} .$$

Determine (i) the work done in carrying a 4.0-C charge from  $B(3, 4, 1)$  to  $A(0, 5, 1)$  along the straight line path from  $B$  to  $A$  and (ii) determine the potential difference  $V_{AB}$ . (iii) Repeat part (ii) when the path is the shorter arc of the circle  $x^2 + y^2 = 25$ ,  $z = 1$ .

4. Assume that the  $x$ - $y$  plane is a charge-free boundary separating two dielectric media with permittivities  $\epsilon_1$  and  $\epsilon_2$ , respectively. If the electric field in medium 2 is  $\vec{E}_2 = \hat{x}2 - \hat{y}3 + \hat{z}3$  V/m,  $\epsilon_{R1} = 2$  and  $\epsilon_{R2} = 8$ , determine  $\vec{E}_1$ .