

# Electrodynamics (PHY 514) : 2006

## Assignment 5 :

This problem set is due **Thursday February 2**, at the end of the lecture. Feel free to discuss the problems with others in the class, but you must write your own solutions. Simply writing the answer without showing a derivation will obtain zero credit.

1. A  $1 \mu\text{C}$  charge is placed 1 cm from the axis of an infinite, conducting cylinder of radius  $b = 2$  cm. What is the force on the charge?
2. Using the reciprocity theorem, and the green function inside a closed conducting cylinder of radius  $a$ , and length  $L$ , find the potential inside this cylinder due to a ring of charge  $Q$  of radius  $\bar{\rho}$  located a distance  $\bar{z}$  from one end. What is the force on the ring?
3. A closed conducting cylinder of radius  $a$  aligned along the z-axis extends from  $z = -c$  to  $z = +c$ . Both ends are divided into two regions. At  $z = +c$  the region from  $r = 0$  to  $r = b$  is held at potential  $+V_0$ , while the region from  $r = b$  to  $r = a$  is grounded. At  $z = -c$  the region from  $r = 0$  to  $r = b$  is held at potential  $-V_0$ , while the region from  $r = b$  to  $r = a$  is grounded. The rest of the cylinder is grounded. Find the potential everywhere inside the cylinder in terms of Bessel functions. Also, give the potential in terms of modified Bessel functions.
4. Two infinite conducting planes located at  $z = 0$  and  $z = c$  are joined by a cylinder aligned along the z-axis of radius  $a$ . The potential on the cylinder is

$$V(\rho = a, \phi, z) = V_0 \frac{z}{c} . \quad (1)$$

Find the potential at all points outside the cylinder in terms of modified Bessel functions.