ECE 3105: Electromagnetic Fields

Summer-I 2006, 3 credits, CRN: 60358: Test#3

Dr. Pushkin Kachroo
The Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA 24061-0111,
pushkin@vt.edu

1. (a) State the Maxwell's equations for Electricity and Magnetism in differential and integral forms that show ALL the terms. Show which terms are zero for the static case. (5 points); (b) How's the electric field related to electric potential? (1 point); (c) What is the force experienced by a charge q in an electric field $\mathbf{E}(x, y, z)$ at a point (x,y,z)? (1 point); (d) What is the work done in moving a unit charge in an electric field $\mathbf{E}(x, y, z)$ from point A to point B following a given path (or curve) ? (1 point); (e) Write the expression for the work done in part (d) in terms of the electric potential. (1 point), (f) What is the electric potential at a distance of r from a charge Q. (1 point)
2. Determine the resistance of the insulation in a length ℓ of coaxial cable as shown in Fig. 1. (5 points)

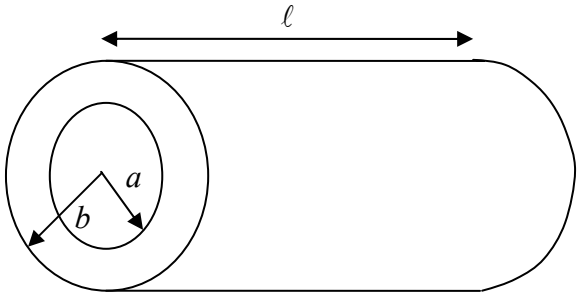

Figure 1

3. Find the capacitance of a coaxial capacitor as shown in Fig.1. (5 points)
4. Derive Poisson's and Laplace's equations from Maxwell's equations. (5 points)
5. (a) Solve the Laplace's equation for a capacitor that has potential zero at bottom conductor, and has potential 100V at $z = d$. After solving for the potential as a function of z, find the electric field as well. (5 points)
   (b) Suppose the electric potential is a function of only x, and y. Solve the Laplace's equation in Cartesian coordinates. (5 points)