ECE 3105: Electromagnetic Fields

Summer-I 2006, 3 credits, CRN: 60358: Test#5

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

1. Do the following:
   a. (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. (2 points);
   b. (b) How's the electric field related to electric potential, and magnetic field related to magnetic potential? (1 points);
   c. (c) What is the force experienced by a charge q moving with a velocity $\mathbf{v}$ in an electric field $\mathbf{E}(x, y, z)$ and magnetic field $\mathbf{B}(x, y, z)$? (1 points);
   d. (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. (e) Write the expression for the work done in part (d) in terms of the electric potential. (1 point),
   f. (f) What is the electric potential and electric field at a distance of r from a charge Q. (1 point).
2. Derive the partial differential equations for transmission lines. (5 points)
3. Assuming that the source signal is a sinusoidal signal of a fixed frequency. Derive the ordinary differential equations for the voltage and current phasors. (5 points)
4. Find the general solution that satisfies the differential equations derived above. (5 points)
5. Derive the expression for the pointwise impedance at a point at a distance x from the load in terms of the pointwise reflection coefficient. (5 points)
6. For a lossless line find the relationship between the voltage standing wave ratio VSWR and the boundary reflection coefficient. (5 points)