1. (15%)  
Two lossy homogenous dielectric media with dielectric constants $\epsilon_{r1} = 2$, $\epsilon_{r2} = 3$, and conductivities $\sigma_1 = 15 (mS)$, $\sigma_2 = 10 (mS)$ are in contact at the $z = 0$ plane. In the $z > 0$ region (region 1) a uniform electric field $\vec{E}_1 = 20\vec{a}_z - 50\vec{a}_y$ (V/m) exists. Find, in region 2, (a) the electric field $\vec{E}_2$ (5%), (b) the current density $\vec{J}_2$ (5%), (c) the polarization vector $\vec{P}_2$ (5%).

2. (10%)  
Between the inner and outer conductors of a coaxial cable that has an inner conductor of radius $a$ and outer conductor of inner radius $b$ and a medium with permittivity $\varepsilon$ and conductivity $\sigma$. Find (a) the capacitance per unit length. (5%) (b) the leakage resistance per unit length. (5%)

3. (15%)  
The inner and outer radii of two concentric, thin, conducting, spherical shells are $R_i$ and $R_o$, respectively. The space between the shells is filled with insulating material. The inner shell is connected to ground and the outer shell is maintained at a potential $V_0$. Between the shells, (a) find the electric potential distribution $V$ (8%) (b) the electric field $\vec{E}$ (7%).

4. (10%)  
For a positive charge $Q$ is located at the center of two concentric, thin, conducting, spherical shells with inner and outer radii $R_i$ and $R_o$, respectively. The space between the shells is filled with material with relative permittivity $\varepsilon_r = 2$. Determine everywhere the (a) the electric potential distribution $V$. (5%) (b) the electric field $\vec{E}$. (5%)
5. (10%) A proton having an initial velocity of $1.0\times10^6 \hat{i}$ m/s enters a uniform magnetic field of magnitude 0.100 T with a direction perpendicular to the proton's velocity. Find the radius of curvature of the proton's path while in the field. The mass of proton is $1.67\times10^{-27}$ kg.

6. (10%) A long, straight wire of radius $R$ carries a steady current $I$ that is uniformly distributed through the cross section of the wire. Calculate the magnetic field a distance $r$ from the center of the wire in the region (a) (5%) $r \geq R$, (b) (5%) $r < R$.

7. (10%) The electric field intensity of a uniform plane wave in free space is given by $\vec{E} = 94.25 \cos(\omega t + 6z) \hat{j}$ V/m. Determine (a) (5%) the wave frequency and (b) (5%) the wavelength.

8. (20%) The electric field intensity of a uniform plane wave propagating in free space is known to be $377 e^{-j0.866z} e^{-j0.5y} \hat{i}$ V/m. It strikes a dielectric medium ($\varepsilon_r = 9$) at $30^\circ$ with respect to the normal to the plane interface. Determine the (a) (10%) electric field intensity and (b) (10%) magnetic field intensity of the transmitted wave. Assume that the permeability of the medium is the same as that of free space. Here $\hat{i}, \hat{j}, \hat{k}$ represents unit vectors along the $+x, +y$ and $+z$ directions, respectively.