

1. Make a two-dimensional sketch of the equipotential lines and the electric field lines for an electric dipole (20%)
2. An infinitely long, thin conducting circular cylinder of radius b is split in four quarter-cylinders. The quarter-cylinders in the second and fourth quadrants are grounded, and those in the first and third quadrants are kept at potentials V_0 and $-V_0$, respectively. Determine the potential distribution both inside and outside the cylinder. (20%)
3. An air coaxial transmission line has a solid inner conductor of radius a and a very thin outer conductor of inner radius b . Determine the inductance per unit length of the line. (20%)
4. A standard air-filled S-band rectangular waveguide has dimensions $a=7.21\text{cm}$ and $b=3.40\text{cm}$. What mode types can be used to transmit electromagnetic waves having the wavelength of $\lambda=10\text{cm}$? (20%)
5. A perpendicularly polarized uniform plane wave in air of frequency f is incident obliquely at an angle of incidence θ_i on a plane boundary with a lossy dielectric medium that is characterized by a complex permittivity $\epsilon_2 = \epsilon' - j\epsilon''$. Let the incident electric field be

$$\vec{E}_y(x, z) = \hat{y}E_{i0} \exp[-jk_0(x \sin \theta_i - z \cos \theta_i)]$$
 - (a) Find the expressions of the transmitted electric and magnetic field intensity phasors in terms of the given parameters. (10%)
 - (b) Show that the angle of refraction is complex and the transmitted field \vec{H}_t is elliptically polarized. (10%)