HW1

1. The Direct Broadcast Satellite (DBS) is placed 36,000 km above the sea level, at the geostationary orbit. The receiver on the earth is a 12” (30 cm) dish antenna with an aperture efficiency of 80%. The frequency of operation is 11.7-12.2 GHz (500 MHz bandwidth).
   1. Calculate the gain of the receiver antenna in dB.
   2. Calculate the space loss factor between the satellite and receiver.
   3. If the gain of the transmit antenna on the satellite is 33 dB. What is the size of the transmit antenna if its aperture efficiency is 85%? What is the footprint of the beam from the transmit antenna on the earth?
   4. Can we use a transmit antenna with a gain of 43 dB on the satellite in order to cover the entire U.S.A.?
2. A transmit antenna produces a maximum electric field intensity at the far field in a certain direction given by: (V/m). Where I is the peak value of the antenna current. The input resistance of this lossless antenna is 50 ohm. Find the maximum effective aperture of the antenna.
3. The electric field of a uniform plane wave traveling along the negative z-direction is given by and is incident upon a receiving antenna placed at the origin and whose radiated electric field, toward the incident wave, is given by , where E0 and E1 are constants. Determine the following:
   1. Polarization of the incident wave, and why? Sketch the sense of rotation and determine if it is left-handed or right-handed, or linear.
   2. Polarization of the antenna, and why? Sketch the sense of rotation and determine if it is left-handed or right-handed, or linear.
   3. Losses (dimensionless and in dB) due to polarization mismatch between the incident wave and the antenna.
4. Consider the current density , where α and β are real constants.
   1. Find the far-field average power density
   2. Find the values of α and β that make the radiation pattern as nearly isotropic as possible. Calculate the resulting directivity (should be as close to 1 as possible)
5. Consider the magnetic current , , , , where α and β are complex constants.
   1. Calculate the far field pattern for α=1 and β=2 and identify the direction of the electric field at (, , and
   2. Choose α and β to yield circular polarization at
   3. Choose α and β to yield circular polarization at (