KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 672 SATELLITE COMMUNICATIONS

HOME WORK # 3

1. The maximum radiation intensity of a 90% efficiency antenna is 200 mW/sr. Find the directivity and gain (dimensionless and in dB) when the radiated power is 40π mW. Repeat the same problem if the input power is 40π mW.

2. The normalized radiation intensity of a given antenna is given by:

   a. $U = \sin\theta \sin\phi$.
   b. $U = \sin\theta \sin^2\phi$.
   c. $U = \sin^2\theta \sin\phi$.
   d. $U = \sin^2\theta \sin^2\phi$.

   The radiation intensity exists only in the $0 \le \theta \le \pi$, $0 \le \phi \le \pi$ region, and is zero elsewhere. Find the exact directivity (dimensionless and in dB), and the azimuth and elevation half-power beamwidths.

3. Transmitting and receiving antennas operating at 1GHz with gains of 20 and 15 dB respectively, are separated by a distance of 1 km. Find the maximum power delivered to the receiver when the input power is 150 W. Assume that:

   a. The antennas are polarization matched
   b. The transmitting antenna is circularly polarized (either right or left hand) and the receiving antenna is linearly polarized.

4. A satellite carrying an 11.7 GHz continous-wave (CW) beacon transmitter is located in geo-synchronous orbit 38000 km from an earth station. The beacon's output power is 200 mW, and it feeds an antenna with an 18.9 dB gain toward the earth station. The earth station receiving antenna is 3.6 m in diameter and has an aperture efficiency of 50%.

   a. Calculate the satellite EIRP in W and dBW.
   b. Calculate the receiving antenna gain in dB.
   c. Calculate the path loss in dB.
   d. Calculate the received signal power in W, mW, and dBm.