Series 3

Exercise 1

An airplane is flying at an altitude of 2km above the ground, and has an antenna mounted under its fuselage. This antenna should transmit a power density which should be constant n the ground within a cone of which summit is the antenna. The revolution axis of the cone is the vertical line between the antenna and the ground, the airplane is the summit of the cone and the aperture angel of the cone from this axis is of 45°. The antenna should not transmit outside of the cone, and the ground is perfectly flat.

1) Find the expression of the radiation pattern as a function of θ measured form the cone axis.
2) Compute the directivity of the antenna ?

Exercise 2

At a certain frequency, the transmission between two antennas gives a ratio between received power and transmitted power of -60dB. One of the antenna is a parabolic reflector, the other a very short dipole of which the directivity does not depend on the frequency over a large frequency band. We now double the frequency. What is now the new ration between received power and transmitted power ?

Exercise 3

Three lossless antennas A, B and C operating at 10GHz have unknown directivities, that we want to determine. To this aim, we realize a transmission system with a measurement distance of 1 m between the antennas, and a transmission power of 1W. We supposed the antennas are matched to the transmitter or the receiver, respectively. We test different antenna combinations on the transmitter and the receiver, and measure the received powers (always orienting the antenna such as to maximize this received power):

Pr = 6 mW for a tranmission between A and B,

Pr = 10 mW for a tranmission between A and C,

Pr = 1 mW for a tranmission between B and C.

What is the maximal directivity of each antenna ?