UNIVERSITÀ DEGLI STUDI DI BRESCIA

Exercise 1 (12 points)

a) Define directivity, gain and radiation efficiency; explain the importance of these parameters.

b) Define the effective area and explain how it is related to the gain.

c) Define the effective length (or effective height) and obtain a formula giving the effective length as a function of the effective area.

d) Obtain and explain the Friis transmission equation.

Exercise 2 (12 points)

a) Define and explain the linear polarization of the electromagnetic field (in the time domain and in the phasor domain). Give an example of a source emitting a linearly polarized field.

b) Define and explain the circular polarization of the electromagnetic field (in the time domain and in the phasor domain). Give an example of a source emitting a left-hand circularly polarized field.

c) Starting from Maxwell's equations, prove that if the electric field is linearly polarized the magnetic field is linearly polarized, as well.

d) Starting from Maxwell's equations, prove that if the electric field is left-hand circularly polarized the magnetic field is left-hand circularly polarized, as well.

Exercise 3 (10 points)

A uniform array is composed of 4 isotropic antennas. The signal frequency is 3 GHz, the distance between two neighbouring antennas is 4 cm and the phase delay from one antenna to the next is $-4\pi/5$ radians.

a) Find the maximum directions and the null directions of the radiation pattern.

b) Plot the radiation pattern.