Microwave Engineering and Antenna – Tutorial 2

Question 1

A uniform plane wave is propagating in direction of the positive z -axis. Find the polarization (linear, circular, or elliptical), sense of rotation (CW or CCW), axial ratio (AR), and tilt angle τ (in degrees) for

a) $E_x = E_y$ and $\Delta\phi = 0$

b) $E_x \neq E_y$ and $\Delta\phi = 0$

c) $E_x = E_y$ and $\Delta\phi = \pi/2$

d) $E_x = E_y$ and $\Delta\phi = -\pi/2$

Question 2

A linearly polarized wave traveling in the negative z -direction has a tilt angle τ of 45 degrees. It is incident upon an antenna whose polarization characteristics are given by

$$\overline{\rho}_a = \frac{4\bar{a}_x + j\bar{a}_y}{\sqrt{17}}$$

Find the polarization loss factor (PLF) dimensionless and in dB.

Question 3

The normalized E field pattern o fan antenna, independent of frequency, varies as follows:

$$\frac{E}{E_0} = \begin{cases} 1 & 0^\circ \le \theta \le 45^\circ \\ 0 & 45^\circ \le \theta \le 90^\circ \\ \frac{1}{2} & 90^\circ \le \theta \le 180^\circ \end{cases}$$

a) What is the directivity of this antenna?

b) What is the radiation resistance of the antenna at 200 m from it if the field is equal to 10 V/m (rms) from $\theta = 0^\circ$ at the distance and the terminal current is 5 A (rms) ?

Question 4

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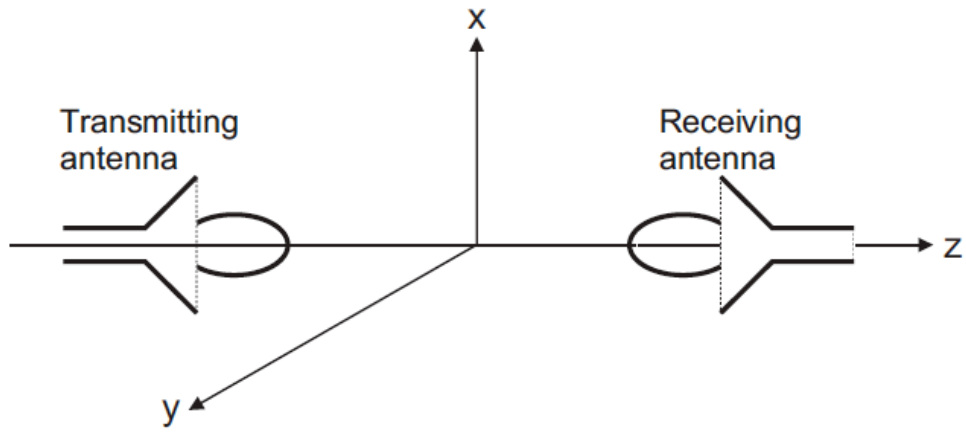
A right-hand circularly polarized horn antenna is used as a transmitter in a radio link. The antenna is fed by a 50 Ω line, and radiates (at output) 5 W of power at 2 GHz. The gain of the antenna is 30 dBi, its radiation resistance 47 Ω and loss resistance 5 Ω. The receiving antenna is 95% efficient and has an impedance mismatch at its terminals, which leads to a VSWR of 1.7. The receiving antenna is CW elliptically polarized with tilt angle of 0^0 and axial ratio (AR) of 2. The distance between the two antennas is 3500 km, and the receiving antenna is required to deliver 0.5·pW to the receiver.



a) Calculate the total efficiency of the transmitting antenna
b) Calculate the power density incident on the receiving antenna
c) Find the polarisation loss factor
d) Determine the maximum effective aperture of the receiving antenna