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HOMEWORK SET #1

Note: Please show all the steps leading to the final answer. Also, dB unit can be obtained by $A[dB] = 10\log_{10}(A)$.

1. A hypothetical isotropic antenna is radiating in free-space. At a distance of 100 m from the antenna, the total electric field (E_θ) is measured to be 5 V/m. Find the
   (a) power density (W_{rad})
   (b) power radiated (P_{rad})

2. The maximum radiation intensity of a 90% efficiency antenna is 20 mW/steradian. Find the directivity and gain (in dB) when the
   (a) input power is 125.66 mW
   (b) radiated power is 125.66 mW

3. In target-search ground-mapping radars, it is desirable to have echo power received from a target, of constant cross section, to be independent of its range. For one such application, the desirable radiation intensity of the antenna is given by

$$U(\theta,\phi) = \begin{cases} 1 & 0 \le \theta < 20^\circ \\ 0.312\csc(\theta) & 20^\circ \le \theta < 60^\circ \\ 0 & 60^\circ \le \theta < 180^\circ \end{cases} \quad (1)$$

   Find the directivity in dB.

4. An elliptically polarized wave traveling in the negative z-direction is received by a circularly polarized antenna. The unit vector describing the polarization of the incident wave is given by

$$\hat{\rho}_w = \frac{2\hat{x} + j\hat{y}}{\sqrt{5}} \quad (2)$$

   Find the polarization loss factor (PLF) (in dB) when the wave that would be transmitted by the antenna is
   (a) right-hand CP (RCP)
   (b) left-hand CP (LCP)
   Repeat the problem for the case when the incident wave is a linearly polarized wave given by

$$\hat{\rho}_w = \frac{\hat{x} + \hat{y}}{\sqrt{2}} \quad (3)$$

5. A $\lambda/2$ dipole, with a total loss resistance of 1 Ω, is connected to a generator whose internal impedance is $50 + j25\Omega$. Assuming that the peak voltage of the generator is 2V and the impedance of the dipole, excluding the loss resistance, is $73 + j42.5\Omega$, find the average power
   (a) supplied by the source
   (b) radiated by the antenna
   (c) dissipated by the antenna