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HOMEWORK SET #5

Note: Please show all the steps leading to the final answer.

1. Design a lossless resonant circular loop operating at 10 MHz so that its single turn radiation resistance is 0.73 Ohms. The resonant loop (i.e., it has zero reactance) is to be connected to a 300-Ω load through a balanced "twin-head" 300-Ω transmission line. Determine:
   (a) The radius of the loop (in meters and wavelengths)
   (b) The number of turns the loop must have to minimize the reflection coefficient between the loop and the transmission line
   (c) For the loop of part (b), determine the power that can be delivered to the load if an incident wave (polarization matched to the antenna) has a power density of 1 $\mu W/m^2$ and is incident in a direction such that the maximum open circuit voltage is induced.
2. A very small circular loop of radius $a(a << \lambda/6\pi)$ and constant current I_0 is symmetrically placed about the origin at $x = 0$ and with the plane of its area parallel to the $y - z$ plane. Find the
   (a) spherical $\mathbf{E}$ and $\mathbf{H}$ radiated by the loop in the far-zone
   (b) directivity of the antenna
3. A very small loop antenna $(a << \lambda/30)$ of constant current is placed a height h above a flat, perfectly conducting ground plane of infinite extent. The area plane of the loop is parallel to the interface ($x - y$ plane). For far-field observations
   (a) find the total electric field radiated by the loop in the presence of the ground plane
   (b) all the angles (in degrees) from the vertical to the interface where the total field will vanish when the height is λ.