**Problem Solutions to assigned problems from Balanis**

**5.3)** Find the radiation efficiency of a single-turn and a 4-turn circular loop each of radius $\lambda/10\pi$ , and operating at 10MHz. The radius of the wire is $10^{-3}\lambda$ and the turns are spaced $3\times10^{-3}\lambda$ . Assume the wire is copper with a conductivity of $5.7\times10^{7}$ S/m, and the antenna is radiating into free-space.

Solution: $e_{cd}$(N=1) = 92% $e_{cd}$(N=4) = 97%

**5.4)** Find the power radiated by a small loop by forming the average power density, using (5.27a) –(5.27c), and integrating over a sphere of radius r. Compare the answer with (5.23b).
Solution: should be equal

**5.12)** A constant current circular loop of radius $a = 5\lambda/4$ is placed on the x-y plane. Find the two smallest angles (excluding $\theta = 0$ ) where a null is formed in the far-field.
Solution: $\theta_{nulls}$ = 29.3$^{o}$ and 63.2$^{o}$

**5.13)** Design a circular loop of constant current such that its field intensity vanishes only at $\theta = 0$ ( $\theta = 180^{o}$ ) and $\theta = 90^{o}$ . Find its radius, radiation resistance, and directivity.

Solution: C= 3.84 λ, a= 0.61115 λ, $R_{rad}$ = 2.27 k ohms
D = 2.619

**5.24)** A circular loop of non-constant current distribution, with circumference of $1.4\lambda$ , is attached to a 300-ohm line. Assuming the radius of the wire is $1.555\times10^{-2}\lambda$ , find the

a) Input impedance of the loop
b) VSWR of the system
c) Inductance or capacitance that must be placed across the feed points so that the loop becomes resonant at $\theta = 0$

(Hint: see example of section 5.2.7)

**Solution**:
$Z_a$= 300 -j55 ohms
VSWR = 1.2
L = 2.7 μH