University of Tehran
School of Electrical and Computer Engineering
Antenna Theory, Spring 2017
Instructor: Dr. L. Yousefi

Homework#4 Due Date: 09 Ordibehesht

Q1, 30 Marks

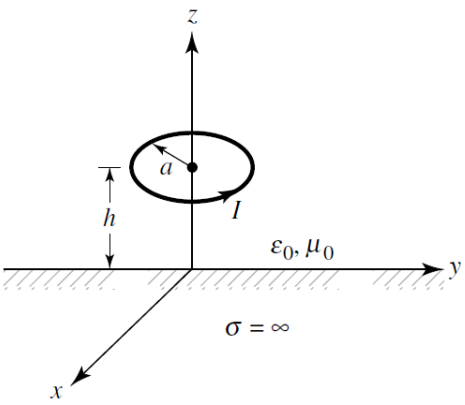
Consider a circular loop of wire of radius *a* on the x-y plane and centered at the origin. Assume that the current on the loop is given by

$$I(\phi') = I_0 + 2\sum_{n=1}^{M} I_n \cos(n\phi')$$

Where ϕ' is measured from the feed point of the loop along the circumference .By finding the far-zone fields of the mth term in the fourier series $I_m \cos(m\phi')$, show that radiation fields of the loop can be derived in terms of the Bessel functions of the first kind and different orders**.**

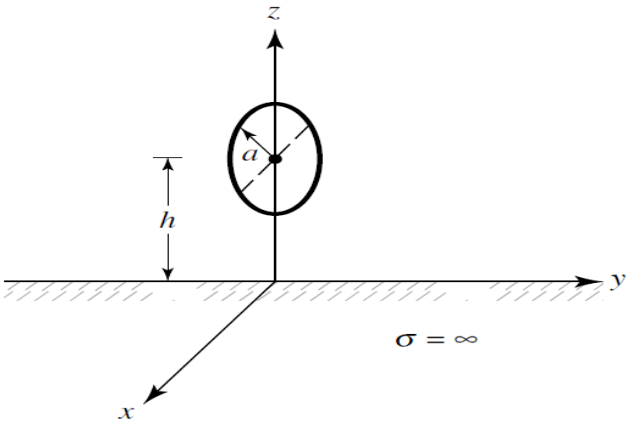
Q2, 20 Marks

A very small loop antenna (a < λ/30) of constant current is placed a height *h* above an infinite PEC. The area plane of the loop lies in the x-y plane, parallel to the PEC plane. Find the far-zone radiation field of the antenna, and also the angles θ (in degrees) in which the total field will vanish when the height is λ.



Q3, 20 Marks

Repeat Q2 when the loop is perpendicular to the PEC plane as shown below.



Q4, 20 Marks

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Consider a square loop with side length of *a*, lying in the x-y plane and with its center at the origin. If the current in the loop is assumed to be constant, and equal to I_0, find the far-zone radiation field. Compare your results with the formula derived in Balanis's book, for a specific case.

Q5, 10 Marks

A small circular loop with circumference $C = \lambda/20$ is used as a receiving antenna. A uniform plane wave traveling along the *x*-axis and toward the positive x direction, whose electric field is given by

$$E^i = (2\hat{y} + \hat{z})e^{-jkx}$$

is incident upon the antenna. Determine the open circuit voltage induced in the loop.