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

Homework#1 Due Date: 07 Esfand

Q1, 20 Marks

Assuming a Magnetic current, $\bar{M}$ radiating in an unbounded homogeneous medium. Prove that in the far-field zone, radiated fields obey the following relationships:

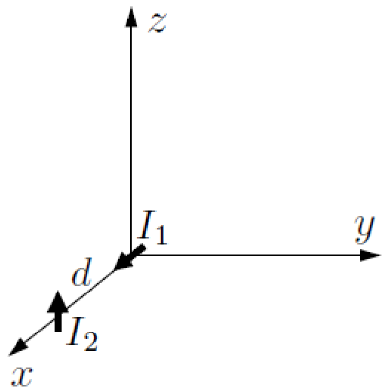
$$H_r \simeq 0 \qquad E_r \simeq 0$$
$$H_\theta \simeq -j\omega F_\theta \qquad E_\theta \simeq -j\omega\eta F_\phi = \eta H_\phi$$
$$H_\phi \simeq -j\omega F_\phi \qquad E_\phi \simeq +j\omega\eta F_\theta = -\eta H_\theta$$

Q2, 20 Marks

Assume an Electric current source $\bar{J} = \delta(\vec{r})\hat{U}$, radiating in an isotropic unbounded and homogenous region, where $\hat{U}$ is a unit vector in an arbitrary direction. Find the scalar differential equations for the Magnetic potential vector. You don't need to solve the equations.

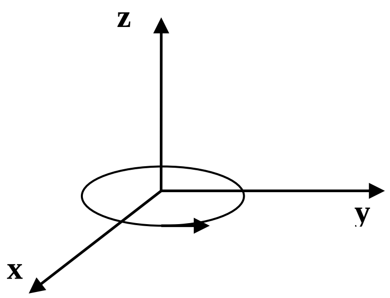
Q3, 20 Marks

Calculate the radiation field (far field) of the impulse currents shown in the figure below.



Q4, 20 Marks

Find the radiated (Far-Zone) field of an Electric current loop. The loop lies in the x-y plane, with its center at the origin, and the radius of a<<λ. The loop carries the constant current of I= $I_0\hat{\varphi}$.



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Q5, 20 Marks

A uniform magnetic surface current density of $Ms = M0\hat{x}$ is distributed on a rectangular area on the xy-plane given by |x| < a/2 and |y| < b/2. Calculate the radiated Electromagnetic field and the normalized radiation intensity.

Q6*, 20 Bonus Marks

For a homogenous medium, starting from Maxwell's equation and applying Lorentz's Gauge, we derived wave equation for the Magnetic potential vector, $\bar{A}$. Now assuming that the medium is not homogeneous, $\varepsilon = \varepsilon(x, y, z)$, and, $\mu = \mu(x, y, z)$, starting from Maxwell's equations, drive the modified equation for the Magnetic potential vector, $\bar{A}$.