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

Homework#6 Due Date: 20 Khordad

Q1, 20 Marks

A long linear (traveling wave) antenna of length *l* positioned along the *z*-axis and fed at the *z* = 0, is terminated in a load at the *z* = *l* end. There is a nonzero reflection at the load such that the current distribution on the wire is given by

$$I(z) = I_0 \frac{e^{-jkz} + Re^{jkz}}{1+R}, \quad 0 \le z \le l$$

Determine as a function of R and *l* the
(a) far-zone spherical electric-field components
(b) Radiation intensity in the $\theta = \pi/2$ direction

Q2, 20 Marks

The current distribution on a terminated and matched long linear (traveling wave) antenna of length *l*, positioned along the x-axis and fed at its one end, is given by

$$\mathbf{I} = \hat{\mathbf{a}}_x I_0 e^{-jkx'}, \quad 0 \le x' \le 1$$

Find the far field electric and magnetic field components.

Q3, 20 Marks

Design a symmetrical two-wire plane spiral *($\varphi_0 = 0, \pi$)* to operate at frequencies higher than 10 MHz with total feed terminal separation of $10^{-3}\lambda$. The total length of each spiral should be one wavelength
(a) Determine the rate of spiral of each wire.
(b) Plot the geometric shape of one wire.

Q4, 20 Marks

Consider a rectangular aperture located at $-a/2 \le x \le a/2$ and $-b/2 \le y \le b/2$ on a (perfectly conducting) infinite ground plane. For the following field distribution, find the far-field radiation.

$$E_y^a = E_0 \cos\frac{\pi x}{a} \cos\frac{\pi y}{b}$$

Q5, 20 Marks

Using the cavity model for the rectangular microstrip patch antenna shown in the figure below, analytically calculate the radiated field for the TM^z_{110} mode.

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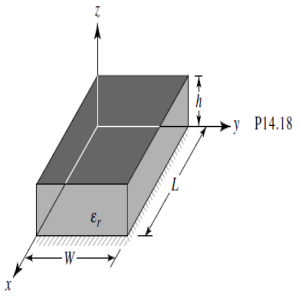

Q6*, 20 Bonus Marks

X band WR90 rectangular waveguide apertures are mounted on an infinite ground plane forming a rectangular array of 8-by-8 elements. The center-to-center spacing between adjacent waveguides is dx = dy =0.82 λ. Dimensions of each waveguide are a = 22.86mm and b = 10.16mm. This planar array is uniformly excited with maximum radiation at broadside. Find the directivity of the array operating at 10GHz.

Q7*, 20 Bonus Marks

A perpendicularly polarized plane wave is obliquely incident upon an aperture, with dimension a and b, on a PEC ground plane of infinite extent. Assuming the field over the aperture is given by the incident field (ignore diffractions from the edges of the aperture), find the far-zone radiation field for x > 0.