Microwave Engineering and Antenna – Tutorial 4

Question 1

Three isotropic sources, with spacing d between them, are placed along the z-axis. The excitation coefficient of each outside element is unity, while that of the center element is 2. For a spacing of $d = \lambda/4$ between the elements, find the

a) array factor,

b) angles (in degrees) where the nulls of the pattern occur $(0° \leq \theta \leq 180°)$,

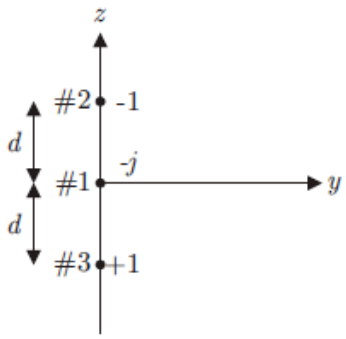
c) angles (in degrees) where the maxima of the pattern occur $(0° \leq \theta \leq 180°)$.

Question 2

A three-element array of isotropic sources has the phase and magnitude relationships shown in the figure below. The spacing between the elements is $d = \lambda/2$.

a) Find the array factor.

b) Find the nulls.

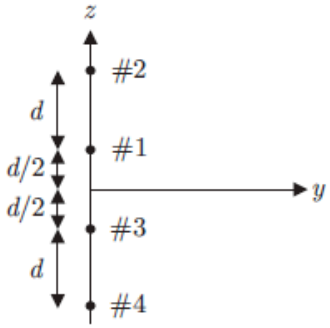


Question 3

Four isotropic sources are placed along the z-axis as shown in the figure below. Assuming that the amplitudes of elements #1 and #2 are +1, and the amplitudes of elements #3 and #4 are -1 (180° out of phase with #1 and #2), find

a) the array factor in simplified form,

b) all the nulls when $d = \lambda/2$.



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Question 4

Show that in order for a uniform array of N elements not to have any minor lobes, the spacing and the progressive phase shift between the elements must be:

a) $d = \lambda/N$, $\xi = 0$ for a broadside array,

b) $d = \lambda/(2N)$, $\xi = \pm kd$ for an ordinary end-fire array.