



Department of Electrical and Computer Engineering

Antenna Analysis and Design (Spring 2023)

Final Exam

April 26, 2023

1. This exam is to be solely your own work.
2. Note the distribution of points on each problem and the time as you do the exam.
3. Please show all of your work here and explain your procedures.
(Partial credits!)

FULL NAME _____

1. (20 pts) Dipole questions
 - a) (5 pts) Sketch the current distribution for electrically-small dipole, electrically-short dipole, half-wavelength dipole and one-wavelength dipole.
 - b) (5 pts) Rank these antennas in terms of radiation resistance from small to large.
 - c) (5 pts) Rank these antennas in terms of directivity from small to large.
 - d) (5 pts) what are the main issues in using electrically-small dipoles in practice?
2. (20 pts) Answer each of these questions in few lines and think of the most important characteristic of the problem.
 - a) (5 pts) Why don't we use slot antennas around the first resonance?
 - b) (5 pts) How can you design slot antennas to radiate efficiently in one direction?
 - c) (10 pts) Draw the dual of the folded-dipole antenna and let us call it the folded-slot antenna. Plot the field distribution on the folded-slot antenna. What is the input impedance of this antenna at resonance? Sketch its E- and H-plane far-field patterns.
3. (60 pts) A 7-element dipole array is along the y-axis. The orientation of dipoles is along x-axis. The center-to-center spacing between the elements is 1 lambda.
 - a) (5 pts) Sketch the radiation pattern in the Y-Z plane for uniform illumination (in rectangle format).
 - b) (5 pts) Find the half-power beamwidth of the main beam in degrees.
 - c) (5 pts) Find the level of the first and second sidelobes.
 - d) (5 pts) Estimate the directivity of the array.
 - e) (5 pts) The array is scanned to $\theta=30$ degrees in the Y-Z plane. Calculate the phase for each element in the array.
 - f) (5 pts) Sketch the radiation pattern.
 - g) (5 pts) Find the half-power beamwidth of the main beam in degrees.
 - h) (5 pts) Estimate the directivity of the array.
 - i) (5 pts) If you can choose another antenna to avoid grating lobes, which one you would like to use and why?
 - j) (5 pts) If you want to scan the beam to any angle without grating lobes, what is your solution?
 - k) (10 pts) A two-dimensional array is now constructed using this antenna. The center-to-center spacing is 1 lambda in both the X and Y directions. The array contains 11×11 elements. Estimate the directivity for: Uniform illumination; Uniform illumination but scanned to $\theta=30$ degree and $\phi=0$ degree; Chebyshev illumination to result in -30 dB sidelobes in both planes.