

# Introduction to Antennas 2

## Prerequisite

Introduction to Antennas 1.

## Description

This course explores antenna arrays: array factor, uniformly excited equally spaced arrays, pattern multiplication principles, nonuniformly excited arrays, steering beam concept and phased array, as well as feeding networks of arrays. Concepts are applied to realistic projects utilizing the commercial electromagnetic simulator package (HFSS) for antenna analysis and design. Emphasis will be on using simulation to visualize a variety of antenna arrays radiation patterns, impedance matching, Floquet ports and infinite arrays, fabrication of antenna arrays using a milling machine, and measuring the reflection coefficient of the designed array network using the Network Analyzer.

## Course Objectives

After completing this course, students should be able to learn the following:

- Examine linear and planar antenna array fundamentals such as array factor, uniformly excited equally spaced arrays, pattern multiplication principles, nonuniformly excited arrays, phased arrays.
- Describe the concept and function of an array network.
- Utilize Commercial simulation software (HFSS) for antenna array performance analysis.
- Design an antenna array using HFSS.
- Analyze antennas in communication systems.
- Fabricate an antenna array to operate in microwave frequency range.
- Conduct measurements of reflection coefficient of the antenna array and the concept, function and process of the Network Analyzer.

## Textbook

Warren L Stutzman and Gary A. Thiele, Antenna Theory and Design, 3<sup>rd</sup> edition, Wiley 1998.

## Specific topics (Chapters 4, 8, 11, 13)

1. Antenna array fundamentals such as array factor.
2. Linear antenna array: uniformly excited equally spaced arrays.
3. Complete array pattern and pattern multiplication.
4. Directivity of uniformly excited equally spaced linear arrays.
5. Multidimensional antenna array.
6. Mutual coupling in antenna arrays.
7. Array of microstrip antennas.
8. Reciprocity and antenna measurements (pattern and gain).
9. Antennas in free space system in communications.
10. Antennas in a communication system.
11. Visualization using HFSS package (recorded lab tutorial)
12. Fabrication of antenna array using milling machine
13. Measurements of antenna array using the Network Analyzer and anechoic chamber.

## Course Certificate

In order to receive a certificate of completion for this course, you need to submit the required reports of Project 1, Project 2 and Final Project. In the meantime, the Teaching Assistant will help you in revising your projects to achieve satisfactory reports. The fabrication and measurement of your designed antenna will be conducted by the Teaching Assistant as part of your fees paid in this course.