ECE 469

Antennas for Wireless Communications (3 credits)☐

Overview

Course Catalog Description: Aspects of antenna theory and design; radiation from dipoles, loops, apertures, microstrip antennas and antenna arrays.

Prerequisites: 360 or equivalent

Textbook: C.A. Balanis, *Antenna Theory: Analysis and Design*, 3rd edition, John Wiley and Sons, 2005
Class Goals: To get familiar with the general properties and design of various antennas either as single radiators or in the form of linear, circular or planar arrays. The different design techniques in terms of gain, radiation pattern for various applications, including wireless communications are studied in detail.
Course Coordinator: Prof. Christos Christodoulou

Table I: Objectives, Implementation, and Assessment

Objectives		Implementation	Assessment	A	B	C	D	E	F	G	H	I	J	K
O_1	Understand the Fundamental Parameters of Antennas	First 1 week	HW Midterm Exam	X									X	
O_2	Understand the mathematics radiation integrals and auxiliary potential functions	Weeks 2-3	HW Midterm Exam	X										
O_3	Understand the fundamentals of wire and loop antennas and their radiation mechanism	Weeks 4-6	HW Midterm Exam	X	X	X						X	X	X
O_4	Understand the fundamentals of linear arrays and their various design techniques. Uniform and non-uniform arrays	weeks 7-11	HW Final exam	X	X	X						X	X	X
O_5	Understand the fundamentals of aperture antennas	weeks 12-13	HW Final Exam	X	X	X						X	X	X
O_5	Understand the fundamentals of microstrip antenna design	weeks 14-15	HW Final Exam	X	X	X						X	X	X
O_5	Understand the fundamentals of smart antennas in modern wireless communications	Last week	HW Final Exam	X	X	X						X	X	X
O_5	Investigate and design a particular antenna		Paper project	X	X	X						X	X	X

Course Syllabus

Chapter1: **Introduction to Antennas**

Objective: To introduce the student to some general aspects of antennas, the various types and applications

Chapter2: Fundamental Parameters of Antennas
Gain, radiation patterns, efficiency, directivity, far-field and near field concepts, effective aperture, and the radar range equation.

Chapter3: Radiation Integrals and Auxiliary Potential Functions
Magnetic and electric vector potentials and their use in deriving the far-filed patterns of any antenna. The use of the reciprocity theorem is also introduced.

Chapter4: Linear Wire Antennas
Introduce the most basic antenna structure (the dipole antenna). This antenna is analyzed thoroughly as a radiator in free space and in situations where the dipole is placed above a ground plane.

Chapter5: Loop Antennas
Introduce another simple, and very versatile antenna type that comes in different shapes: loop, rectangle, squares etc.

Chapter6: Arrays: Linear, Planar and Circular
Array factor, amplitude and phase excitation for individual array elements, uniform and non-uniform array configurations. Design concepts based on the binomial and Tschebyscheff theories are highlighted. Planar and circular arrays are also introduced.

Chapter12: Microstrip Antennas
Expose the student to low-profile, light-weight, and planar antenna structures that can be used in all kinds of communication applications.

Chapter14: Aperture Antennas
Huygens' and field equivalence principles are introduced and then used to derive the radiation patterns from various aperture shapes.

Chapter 16: Smart Antennas
Adaptive array antennas used in modern antenna design for wireless communications.

Project: Antenna paper