Half day Short course at

2006 IEEE International Workshop on Antenna Technology: Small Antennas and Novel Metamaterials

March 6-8, 2006

Crowne Plaza Hotel in White Plains, New York

Title:

Dielectric Resonator Antennas, Theory and Design

Presenters:

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In recent years there has been a lot of attention to dielectric resonator antennas (DRA). DRAs are antennas made of high dielectric constant materials mounted on a ground plane or grounded dielectric substrate of lower permittivity. The absence of conducting edges improves the radiation efficiency of the DRA that could be as high as 98%. Although the DRA is made of high dielectric constant, wideband performance is achieved and 50% bandwidth is achieved with some DRA's. The dielectric resonator could provide broadside or endfire far field radiation depending on the mode excited. There are many excitation mechanisms that can be used with the DRA to meet many possible design scenarios.

The short course provides an overview for the development of the DRA. The theory and design principles of the dielectric resonator as an effiicient radiator as compared to microstrip antennas. Several excitation techniques are discussed with their applications to different DRA types. The techniques used to enhance the DRA bandwidth are discussed. The technique of further size reduction to the DRA is also considered.

A breif introduction to the numerical technique based on surface integral equations, derived from the equivalence principle, and the method of moments (MoM), is presented. The use of the MoM to compute the natural complex resonant frequency for a specified mode for symmetric resonators is discussed. Computation of the radiation Q factor and the real resonant frequency are presented. Analytic expressions are obtained for the resonant frequency and the Q-factor for a circular disk resonating at different modes. Then the field distribution inside the dielectric disk is computed and plotted at the resonant frequency in order to determine the proper excitation mechanism that excites such a mode. These expressions could be also used to predict the resonant frequencies of some other DRA shapes that deformed from the circular disc shape.

Many numerical techniques can be used to analyze and design DRA of arbitrary cross-sections. Suggestions are given to different commercial codes that can efficiently be used to design DRA. DRA array antennas are also presented.

Copies of presentation slides and journal articles will be provided.

Biography of Dr. Ahmed A. Kishk: Professor of Electrical Engineering (since 1995). He is an Editor of *Antennas & Propagation Magazine*. He was an Editor-in-Chief of the *ACES Journal* from 1998 to 2001. He was the chair of Physics and Engineering division of the Mississippi Academy of Science (2001-2002).

His research interest includes the areas of design of millimeter frequency antennas, feeds for parabolic reflectors, dielectric resonator antennas, microstrip antennas, soft and hard surfaces, phased array antennas, and computer aided design for antennas. He has published over 140 refereed Journal articles and book chapters. He is a coauthor of the ***Microwave Horns and Feeds*** book (London, UK, IEE, 1994; New York: IEEE, 1994). Dr. Kishk received several awards. The latest award was the Microwave Theory and Techniques Society **Microwave Prize** 2004. Dr. Kishk is a ***Fellow*** member of IEEE and member of several societies.