THE UNIVERSITY of TENNESSEE
KNOXVILLE
Department of Chemical & Biomolecular Engineering
COLLEGE OF ENGINEERING

Course Title: Applications of Broadband Dielectric Spectroscopy for Engineering and Materials Research
Codes: CBE 691 (Graduate), CBE 590 (Graduate), CBE 494 (Undergrad)

Instructor: Prof. Joshua Sangoro (Office: Dougherty Engineering Building 326, Email: jsangoro@utk.edu)

Term: Fall 2014

Department: Chemical and Biomolecular Engineering

Schedule: Tuesdays & Thursdays: 2:10 – 3:25 PM (Classroom: TBD)

Course Summary:

Broadband dielectric spectroscopy (BDS) is an experimental technique that probes the interaction of electromagnetic waves with matter in a wide spectral range (10^{-6} Hz – 10^{12} Hz). In this frequency range, detailed information regarding structural dynamics of polar molecular moieties, charge transport as well as interfacial polarization can be obtained. For instance, since the sensitivity of the technique increases with decreasing thickness of a sample capacitor and hence with decreasing amount of sample, it is possible to perform spectroscopic measurements on *quasi-isolated* polymer chains in a special capacitor arrangement with thicknesses down to 2 nm. This course aims at equipping students and researchers with knowledge and skills necessary to competently apply the technique to study diverse classes of non-metals. Case studies involving application of BDS in the following areas will be discussed: (i) proton transport and hydrogen bonding in soft materials, (ii) structural/glassy dynamics in liquids and polymers, (iii) ionic conduction in disordered materials, (iv) dynamics and polarization in inhomogeneous materials such as copolymers, composites and blends, and (v) dynamics of soft materials under mesoscale confinement. As part of the requirements for successful completion of the course, each authorized participant will be expected to select a topic and perform dielectric studies on a system of direct relevance to his/her field of research. A final report and presentation on the selected project will be necessary to complete this course.

The number of participants in this course is limited and restricted to those with heavy research involvement in experimental studies in Physical Sciences and Engineering fields.

References:

1. F. Kremer and A. Schoenhals (Eds.), Broadband Dielectric Spectroscopy, Springer, Berlin, 2003.
2. E. Riande and R. Diaz-Calleja, Electrical Properties of Polymers, Marcel Dekker, New York, 2004.
3. K. Kao, Dielectric Phenomena in Solids, Elsevier, Amsterdam, 2004
4. H. Ohshima (Ed.), Electrical Phenomena at Interfaces and Biointerfaces, Wiley, New Jersey, 2012
5. F. Kremer (Ed.), Dynamics in Geometrical Confinement, Springer, Berlin, 2014.
6. K. L. Ngai, Relaxation and Diffusion in Complex Systems, Springer, New York, 2011