



Texas Southern University  
**MATHEMATICS DEPARTMENT SEMINAR**

Graph Theory in Music Modulation:  
Colorful Hamilton paths in complete directed graphs

Kiran Chilakamarri (Mathematics) and Lucian Zidaru (Music)

Wednesday, Oct. 1, 2014  
2:30 pm – 3:30 pm  
Room 153 at Science Building

*Abstract*

By replacing the functional names of the seventh and ninth chords with numbers representing the number of half-steps, and by introducing permutations of these numbers and introducing the concept of key-forms in order to produce all possible combinations of chords/modulation, Otterstrom opens new possibilities in the use and interpretation of chords, modulation and scales in the tonal system. These ideas intimately connected with mathematical concepts of special permutations, or equivalently special types of Hamilton paths in complete directed graph where edges are colored. The mathematical problem arising from the modulation reduces to finding a special directed Hamilton path using distinct colored arcs in a complete directed graph with no loops on vertices  $1, 2, \dots, n$ , where the arcs colored with colors  $1, 2, \dots, n-1$  so that the arc  $(i, j)$  is colored with color  $(j-i) \pmod{n}$ . This problem was addressed by mathematician Dr. Ernest Bloomfield Zeisler in 1935. Here we reproduce his results in the language of graph theory and pose some new problems.

