Date: **April 6th**

Time: **11:00 AM**

Location: **Maryland Hall 110**

Speaker: **Dr. Albert Ratner**
University of Iowa

Title: **"Combustion Instability: Understanding the interplay of chemistry, flow Patterns, and acoustics"**

Abstract

Combustion instabilities and resulting acoustic oscillations have been a serious technical challenge in the design and operation of combustors for more than 50 years. Instabilities in combustion systems such as gas turbines or rocket motors can be both physically destructive and cause significantly higher pollution levels. To examine these physical processes, a custom-made combustion-acoustics chamber has been developed that allows for observation of flame dynamics in an environment where both the mean (1 to 5 bar) and the dynamic (20 to ~700 Hz) pressure can be specified. The conditions in this chamber are uniform over the flame volume allowing, when combined with Planar Laser Induced Fluorescence (PLIF) of the hydroxyl radical (OH), the study of the local coupling between the flame and the pressure field.

This seminar will include recent results from testing of a low-swirl premixed burner. Burners of this type are currently being introduced into gas turbines, drying furnaces, and other industrial applications. Measurements reveal that this burner has several different behavioral regimes across the frequencies tested. A subset of lower frequencies (~60 to 120 Hz) create a shear layer instability that drives flame heat release oscillations by local (vorticity driven) flame deformation. Higher frequency testing uncovered a small range (~200 to 230 Hz) where the flame base exhibits a vertical oscillation and a tendency towards instability. This oscillation appears to result from a variation in flame intensity caused by a fluctuation in incoming flow velocity, where the velocity changes occur due to the standing acoustic wave. Since the two types of flame instability are the result of different mechanisms, changes designed to minimize one of the instabilities are likely to impact the other. The talk concludes with a discussion of the broader repercussions of this multi-mechanism behavior.