Course: APM598 Introduction to Delay Differential Equations with Applications to the Life Sciences
Location: PSA 113
line #:31185
T & Th 12:00-1:15
Text: An Introduction to Delay Differential Equations with Applications to the Life Sciences, H. Smith, Springer Texts in Applied Math. 2010.
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Delay differential equations are widely used as mathematical models in many fields, spanning engineering, physics, and especially the life sciences. In a delay differential equation, rates of change of state variables can depend on past values as well as present values of state variables. The basic theory for these equations runs parallel to that for ordinary differential equations with one key distinction: the state space is infinite dimensional. I will assume that students have a good background in ordinary differential equations (e.g. MAT475 or APM501). This will allow us to minimize proofs of standard theorems that are quite similar to their ordinary differential equation counterpart and instead to concentrate on applications. In particular, we will cover the following topics:

(a) Existence and Uniqueness of solutions.

(b) Positivity of solutions & differential inequalities.

(c) Stability of equilibria, principle of linearized stability.

(d) Lyapunov functions.

(e) Hopf Bifurcation of periodic solutions.

(f) Dynamical systems, limit sets.

(g) mathematical modeling with delays.

(h) Lots of applications.

The course will develop the standard tools used by applied mathematicians to analyze the qualitative behavior of solutions and it will introduce students to modeling using delay differential equations, especially in the life

sciences. Students will also become comfortable with computer simulations and bifurcation software using MATLAB.

Students may choose to do either a class project, which might lead to a class presentation, or may turn in selected homework exercises in the text.