Departmental Colloquium

Dr. Hongying Shu, University of New Brunswick

Monday, January 28th, 2013

1:00 p.m.

HH-3017

Viral Infection Dynamics: A Global Analysis

Abstract:

Determining sharp conditions for the global stability of equilibria remains one of the most challenging problems in the analysis of models for the management and control of biological systems. Yet such results are necessary for derivation of parameter thresholds for eradication of pests or clearing infections. This applies particularly to models involving nonlinearity and delays. Here, we provide some general results applicable to to immune system dynamics: we consider a viral model with general target-cell dynamics, nonlinear incidence functions, state-dependent removal functions, in nitely distributed intracellular delays and the cytotoxic T lymphocyte response (CTL). This general model admits three types of equilibria: infection-free equilibria, CTL-inactivated equilibria and CTL-activated equilibria. The model admits two threshold parameters: R0 and R1. Under certain assumptions, it is shown that if R0 is less than or equals unity, then the infection-free equilibrium is globally stable and the viruses are cleared. If R0 is greater than unity and R1 is less than or equals unity, then there exists a unique CTL-inactivated equilibrium, which is globally stable and the infection becomes chronic with no sustained immune response; If R1 is greater than unity, then there is a unique CTL-activated equilibrium, which is globally stable implying persistent immune responses. Our results cover and improve many existing ones and include the case when the nonlinear functions are nonmonotonic. This is a joint work with Drs. Lin Wang and James Watmough.