ESE 553 Syllabus – Spring 2008. Instructor: C. Byrnes

1. Introduction.
   - Examples in 1, 2 and 1½ dimensions.
   - Do solutions of dynamical systems exist?
   - Equilibria and periodic solutions.
   - The Poincare map and fixed points in 1D.

2. Mathematical Preliminaries
   - Linear dynamical systems:
     - Stability, Lyapunov functions and the converse theorem of Lyapunov
   - Topological properties in R^n:
     - open and closed sets, continuity, compactness and connectivity.
   - Fixed point theorems
     - The inverse function theorem.
     - The implicit function theorem.
     - Solutions to ordinary differential equations.

3. Equilibrium Theory for Continuous–time systems
   - Local and global behavior
     - Stable, attractive, asymptotically stable
       - ω-limit sets and their basic properties
   - Lyapunov theory
     - Theorems of Lyapunov and LaSalle
     - Linearization, stability of cascade systems
     - Converse theorems
   - Invariant manifolds
     - Stable and unstable manifolds
     - Center manifolds via fixed point theory
     - Applications to local observers, feedback stabilization and set-point control

4. Equilibrium Theory for Discrete–time systems
   - Local and global behavior
     - Stable, attractive, asymptotically stable
       - ω-limit sets and their basic properties
   - Lyapunov theory
     - Theorems of Lyapunov and LaSalle
     - Converse theorems
   - Invariant manifolds
     - Stable and unstable manifolds
     - Center manifolds

5. Nonequilibrium theory
    - Periodic orbits and the Poincare map
    - Periodically forced dynamical systems
    - Planar Dynamical Systems
        - 2-dimensional Hamiltonian systems
        - Poincaré-Bendixson theory
        - Elementary index theory
    - Attractors
        - ω-limit sets of sets and their basic properties
        - dissipative systems
        - the steady-state response of nonlinear systems