Math 821, syllabus

1. Continuation of stability theory: LaSalle invariance priciple, examples.
2. The Poincaré-Bendixson theorem.
3. Integrable versus chaotic systems. Painlevé equations.
   (a) Hamiltonian systems; action-angle variables; completely integrable systems; Lax pairs; symplectic transformations.
   (b) The Painlevé property.
   (c) Painlevé equations.
4. Introduction to asymptotics of ODEs.
   (a) Formal solutions
   (b) Asymptotics of integral representations
5. Eigenvalue problems.
   (a) Self-adjoint problems
   (b) Sturm-Liouville theory
6. Periodic equations and the Poincaré map.
7. Chaos, strange attractors. The Lorenz system.
8. Integrability and chaos in difference equations.
9. Equations on manifolds.

Bibliography: I will mostly rely on my notes. However here are some good books for supplementary reading:

- M. Hirsch, S. Smale, R. Devaney, Differential Equations, Dynamical Systems, and an Introduction to Chaos, Second Edition Academic Press; 2 edition (2003)
- E. Hille, Ordinary Differential Equations in the Complex Domain, Dover Publications (1997)
- E.L. Ince, Ordinary Differential Equations Dover Publications; Repirnt edition (1956)
- E.A. Coddington N. Levinson, Theory of Ordinary Differential Equations, Krieger Pub Co (1984)

- V. I. Arnold, Geometrical Methods in the Theory of Ordinary Differential Equations, Springer (2008)
- V.I. Arnold, Ordinary Differential Equations,, MIT Press (1978)