MA541: Applied Dynamical Systems (3-1-0: 4)

Autonomous and non-autonomous systems, fundamental differences in solution between autonomous and non-autonomous systems, flow in dynamical system, linear and non-linear dynamical systems, stationary points.

Linearized system, classification of stationary points (stable and unstable nodes, stable and unstable focus, saddle points, centers), attracting and Lyapunov Stability, Hartman-Grobman theorem, phase space analysis, local and global stability in non-linear systems, Lyapunov function and stability analysis, boundedness of trajectories, stable and unstable manifolds of an equilibrium.

Homoclinic and heteroclinic orbits, non-linear centers, conservative and reversible systems.

Limit cycles, index theory, Poincare-Bendixson theorem, weakly non-linear oscillations, regular perturbation theory, two-timing method.

Transcritical bifurcation, saddle-node bifurcation, pitch-fork and Hopf-bifurcations.

Period doubling, strange attractor, Lyapunov exponent, Ruelle-Takens embedding theorem, reconstructing an attractor, Smale horseshoe, Fiegenbaum constant and the renormalization idea.

Text Books and References:

1. S. H. Strogatz, “Nonlinear Dynamics and Chaos”, Westview Press, 2nd edition, 2014
2. M. W. Hirsch, S. Smale and R. L. Devaney, “Differential Equations, Dynamical Systems, and an Introduction to Chaos”, Academic Press, 3rd edition,2012
3. L. Perko, “Differential Equations and Dynamical Systems”, Springer, 3rd edition, 2008