

Syllabus for Master's Comprehensive Exam Applied Nonlinear Ordinary Differential Equations

Topics

1. Autonomous systems, phase diagram analysis, linear approximations, index theory, energy methods, Hamiltonian systems, polar coordinates.
2. Periodic solutions, limit cycles, homoclinic and heteroclinic paths, amplitude and frequency estimates, harmonic balance methods, equivalent linear equation, Bendixson's criterion, the Poincare-Bendixson theorem.
3. Perturbation methods, Lindstedt's method.
4. Stability: Poincare stability, Liapunov stability, uniform stability, asymptotic stability, stability of linear systems, stability of zero solution of nearly linear systems, Liapunov methods for determining stability.
5. Bifurcations: Hopf bifurcations, homoclinic and heteroclinic bifurcations.

References

1. Nonlinear ordinary differential equations; an introduction for scientists and engineers, 4th Ed., Dominic W. Jordan and Peter Smith, Oxford University Press, 2007.
2. Nonlinear dynamics and chaos, Steven Strogatz, Westview Press, 2001.
3. Differential equations and dynamical systems, 3rd Ed., Lawrence Perko, Springer, 2006.
4. Elementary differential equations and boundary value problems, 12th Ed., William E. Boyce, Richard C. DiPrima, and Douglas B. Meade, Wiley, 2008.

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