Outline

1. The classical Peano existence theorem.
2. The classical existence & uniqueness theorem.
3. Phase plane analysis.
4. Limit cycles.
5. The Poincare Bendixson theorem.
6. Linearization.
7. Classification of equilibrium solutions of linear and non-linear systems.
8. Energy methods and estimates including Gronwall's inequality.
9. Lyapunov stability.
10. Definition and properties of stiff systems.
11. Basic theory of approximation schemes for ODEs:
    (a) Local truncation error.
    (b) Global error estimates.
    (c) Stability.
    (d) Stiff systems.
12. Practical implementation issues:
    (a) Function evaluation count.
    (b) Local error estimation and adaptive stepsize control.
13. Order and stability of the following schemes:
    (a) Runge-Kutta schemes including the classical embedded scheme.
    (b) Multistep schemes including the classical Adams-Bashforth-Moulton predictor corrector and BDF schemes.

(c)

Extrapolation schemes including Richardson extrapolation and the Bulirsch-Stoer method.

(d)

Stiff schemes including Rosenbrock methods.