

Numerical methods for Ordinary Differential Equations

Prof. Marino Zennaro¹

¹University of Trieste, Department of Mathematics and Geosciences
Email: zennaro@units.it

Timetable:

Course requirements: it is advisable to have attended a basic course in Numerical Analysis.

Examination and grading: Written exam.

SSD: MAT/08 Numerical Analysis

Aim: We present basic numerical methods for initial value problems in ordinary differential equations and we analyse their convergence properties.

Course contents:

Existence and uniqueness of the solution and continuous dependence on the data for the initial value problem $y'(x) = f(x, y(x)), y(x_0) = y_0$.

Classical Lipschitz constant and right hand side Lipschitz constant.

General one-step methods; explicit and implicit Runge-Kutta methods.

Definition of local truncation and discretization error for one-step methods and definition of consistency of order p .

Convergence theorem with order p for one-step methods. Order conditions for Runge-Kutta methods. Order barriers for explicit and implicit methods.

Variable stepsize implementation. Embedded pairs of methods of Runge-Kutta-Fehlberg type.

References:

- E. Hairer, S.P. Norsett, G. Wanner: Solving Ordinary Differential Equations I, Nonstiff Problems, Springer-Verlag, Berlin, 1993.
- J.C. Butcher: Numerical methods for ordinary differential equations. Second edition, John Wiley & Sons, Ltd., Chichester, 2008.
- Lecture notes by the professors.