

Numerical methods for Ordinary Differential Equations

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Timetable: 12 hrs. First lecture on January 12, 2016, 15:00, (dates already fixed, see the calendar), Torre Archimede, Room 2BC/30.

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:

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