Priv.-Doz. Dr. Marcus Wagner
Brandenburg University of Technology, Cottbus; Department of Mathematics, Chair for Optimization

---

Lecture "Analysis III: Integration and Ordinary Differential Equations" (winter term 2006/07) — Contents

4. The convergence theorems of the Lebesgue theory
   A) B. Levi's monotone convergence theorem
   B) Lebesgue's majorized convergence theorem
   C) Fatou's lemma
5. The Riemann integral in the Lebesgue theory
6. Survey of further assertions within the Lebesgue theory
   A) The indefinite integral
   B) Lipschitz functions
   C) Integrals depending on parameters
   D) L^p-spaces and L^p-norms
   E) Multiple Lebesgue integrals
7. Some applications of the Lebesgue integral

C) Ordinary Differential Equations

VI. Basic concepts

1. Classification of differential equations
2. Solution concepts for ODE's
3. Geometrical visualization of the meaning of an ODE
   A) The directional field
   B) The state space

VII. Elementary solution procedures for first-order ODE's

1. Direct quadrature
2. First-order linear equation
   A) Homogeneous linear equation
   B) Inhomogeneous linear equation
3. Bernoulli equation
4. Riccati equation
5. Exact differential equation
6. Separated differential equation
7. Remarks about the numerical solution of first-order ODE's
   A) Euler-Cauchy's polygonal method
   B) Quadrature formulas and the related one-step procedures

VIII. Fundamental theorems about first-order ODE's

1. The Banach space of the continuous functions $C^0[\,a\,,\,b\,]$
2. The Peano existence theorem
3. The Picard-Lindelöf existence and uniqueness theorem
4. Dependence on parameters
5. Reformulation of the fundamental theorems for systems of differential equations and nth order ODE's

IX. Linear differential equations

1. Global existence of solutions
2. Linear equations of nth orderwith variable coefficients
   A) Homogeneous equation
   B) Inhomogeneous equation
3. Linear equations of nth orderwith constant coefficients
   A) Homogeneous equation
   B) Inhomogeneous equation
4. Outlook on systems of first-order linear equations
   A) Systems with variable coefficients
   B) The matrix exponential function
   C) Systems with constant coefficients

X. A list of important topics not treated within this course