

Braunschweig, 9th of January 2017

## Mathematics for engineers IV (Ordinary differential equations)

### 1 differential equations

concepts, conversion into systems of first order, slope field  
modeling growth, oscillator, pendulum  
solving ODEs with Mathematica and Matlab

### 2 simple solution procedures

separation of variables, ODEs in homogeneous variables  
linear ODEs of first order, homogeneous and particular solution, variation of parameters, transient and steady state  
Bernoulli's and Euler's ODE, exact ODEs, integrating factor

### 3 existence and uniqueness

Peano existence theorem, Lipschitz continuity, Picard Lindelöf theorem

### 4 linear ODEs of $n$ -th order

linear differential operators, superposition principle, fundamental system, Wronski determinant, variation of parameters

### 5 linear ODEs with constant coefficients

characteristic polynomial, complex or multiple roots  
harmonic oscillator, aperiodic limit case, resonance

### 6 systems of linear ODEs

### 7 Laplace transform

definition, properties of multiplication, derivative and damping  
solving odes by Laplace transform  
discontinuous right-hand sides, Dirac's  $\delta$ -distribution and impact

### 8 boundary value problems

deformation of a string, Green function

### 9 dynamical systems

Lotka-Volterra equations, phase plot, stationary, stable and asymptotically stable points