Differential Equations

Course booklet

Differential equations for college and university students. Contains direction fields, separation of variables, linear 1st & 2nd order ODEs, LaPlace transforms, and more.

SOWISO

About SOWISO

SOWISO offers:

- a homework, practice and **learning environment**;
- personalised **feedback** on all answer attempts;
- different **testing and assessment** tools;
- customisable **mathematics courses** with explanations, examples, and endless **randomised practice exercises**;
- an authoring tool to **create original material**;
- **learning analytics** giving detailed insight into student performance;
- **integration** with your LMS/VLE.

Our learning environment guides students along as they solve problems. When doing exercises, students can enter open answer calculations or mathematical formulas. The software will analyse their answer and provide targeted feedback and hints helping the student understand the next step in the solution process, and/or highlight any mistakes they made.

SOWISO increases student engagement and saves teachers time checking and grading!

Pricing

SOWISO partners with higher education institutions on a SAAS licensing basis.

The cost for the platform starts at € 5.50 per student per year, with an additional per student per year fee of € 7.50 per course.

A second licensing model is one in which students pay for their own license in our webshop.

Our digital courses are a fully interactive alternative for paper books and offer a personalised and adaptive learning experience that fits today's generation of students.

How are courses structured?

The courses are structured in chapters and subchapters consisting of units. The unit subjects are listed in more detail on the following pages.

Each unit consists of (at least) one theory page and one package of exercises.

Theory pages contain explanations, (randomised) examples and visualisations and (interactive) graphs.

The packages of **exercises** contain on average around 10 exercises. Each of these exercises are randomised, allowing for endless practicing, and include targeted hints and personalised feedback for the students while solving the exercises.

COURSE CONTENT

Chapter 1: Differential equations (26 topics)

1. *Introduction to differential equations (5 topics)*
    a. The notion of differential equations
    b. Notation for ODEs
    c. Order and degree of an ODE
    d. Solution of differential equations
    e. Linear ODEs

2. *Direction field (5 topics)*
    a. Direction field
    b. Euler’s method
    c. Autonomous ODEs
    d. Existence and uniqueness of solutions of ODEs
    e. Solution strategy on the basis of the slope field

3. *Separation of variables (3 topics)*
    a. Differentials
    b. Differential forms and separated variables
    c. Solving ODEs by separation of variables

4. *Linear first-order differential equations (3 topics)*
    a. Uniqueness of solutions of linear first-order ODEs
    b. Linear first-order ODE and integrating factor
    c. Solving linear first-order ODEs

5. *Linear second-order differential equations (4 topics)*
    a. Uniqueness of solutions of linear 2nd-order ODEs
    b. Homogeneous linear 2nd-order ODEs with constant coefficients
    c. Solving homogeneous linear ODEs with constant coefficients
    d. The Ansatz

Example

In order for you to experience Euler's method an interactive version is presented below.

Enlarge the number s of steps in order to see a version with smaller step size, and enter different right hand sides of the differential equation in the input field behind "$\mathrm{dy}/\mathrm{dt} =$". Press the update button to see the result.

Solution

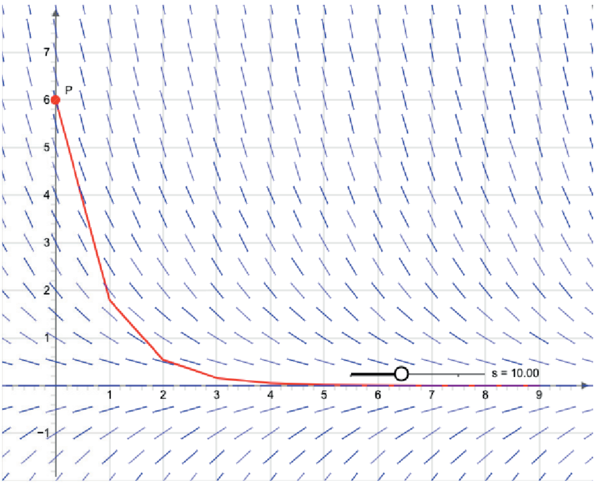
segment length = 0.4 separation = 0.5

xmin = -1 xmax = 10

ymin = -2 ymax = 8

dy/dt = -0.7*y Px = 0 Py = 6

Update Reset



new example

› continue ? ask question

Theory example

6. *Solution methods for linear second order ODEs (4 topics)*
    a. The Wronskian of two differentiable functions
    b. Variation of constants
    c. From one to two solutions
    d. Solving linear second-order ODEs
7. *Systems of differential equations (1 topic)*
    a. Systems of coupled linear first-order ODEs
8. *End of differential equations (1 topic)*
    a. Applications of ODEs

Chapter 2: Differential equations and Laplace transforms (9 topics)

9. *Differential equations and Laplace transforms (9 topics)*
    a. The Laplace transform
    b. The inverse Laplace transform
    c. Laplace transforms of differential equations
    d. Convolution
    e. Laplace transforms of heaviside functions
    f. Laplace transforms of periodic functions
    g. Riemann-Stieltjes intergration
    h. Laplace transforms of delta functions
    i. Transfer and response functions

Missing something? SOWISO allows teachers to create their own content in our authoring environment.

Differential equations: Introduction to Differential equations

Solutions of differential equations

Solve the following initial value problem:

$$\frac{dy}{dt} = \frac{1}{7}y, \quad y(-1) = 6$$

$y(t) = e^t$ — No. The coefficient of t in the power of e or the argument of exp is wrong.

$y(t) = e^{\frac{1}{7}t}$ — Your answer is a solution of the differential equation, but does not meet the initial condition.

$y(t) = e^{\frac{1}{7}t} + 6 - e^{-\frac{1}{7}}$ — No. The main operation in your answer is an addition or a subtraction. See to it that additions and subtractions only appear in the exponent of a power of e or in the argument exp.

$y(t) = 6e^{\frac{1}{7}(t+1)}$ — Way to go

$y(t) = 6 \cdot e^{\frac{1}{7}(t+1)}$

It concerns the differential equation of exponential growth with a constant growth rate $\frac{1}{7}$. According to the theory, the general solution is equal to

$$y(t) = C \cdot e^{\frac{1}{7}t}$$

Substituting the initial condition $y(-1) = 6$ in the general solution leads to the equation

$$6 = C \cdot e^{\frac{1}{7} \cdot -1}$$

This gives

$$C = 6 \cdot e^{\frac{1}{7}}$$

The solution of the initial value problem is

$$y(t) = 6 \cdot e^{\frac{1}{7}} \cdot e^{\frac{1}{7}t}$$

Thiscan be simplified to

$$y(t) = 6 \cdot e^{\frac{1}{7}(t+1)}$$

Theory example

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