Differential Equations I
for Students of Engineering Sciences

Sheet 2, Exercise class

Exercise 1:

Decide which of the following differential equations are linear and which are of second order. Which of the linear equations are homogeneous and which are inhomogeneous?

  a) $(y(t))^2 - (y'(t))^2 = 0$.

  b) $y'(t) - t^2 y(t) = 0$.

  c) $y'(t) - t^2 y(t) - e^{-t} = 0$.

  d) $y''(t) - 2y'(t) + y(t) = t^2$.

  e) $y''(t) + 2y'(t) - y(t)^4 = 0$.

Hint: you don't need to solve the differential equations!

Exercise 2:

For the differential equations b) and c) investigate whether any linear combination

$y(t) := c_1 \hat{y}(t) + c_2 \tilde{y}(t), \, c_1, \, c_2 \in \mathbb{R}$

of two solutions

$\hat{y} : \mathbb{R} \to \mathbb{R}, \, t \mapsto \hat{y}(t) \text{ and } \tilde{y} : \mathbb{R} \to \mathbb{R}, \, t \mapsto \tilde{y}(t)$

solve the differential equation as well.

Justify your results.

Exercise 3:

For the differential equation a) investigate whether every linear combination $y(t) := c_1 \hat{y}(t) + c_2 \tilde{y}(t)$ of two solutions

$\hat{y} : \mathbb{R} \to \mathbb{R}, \, t \mapsto \hat{y}(t) \text{ und } \tilde{y} : \mathbb{R} \to \mathbb{R}, \, t \mapsto \tilde{y}(t)$

solves the differential equation. Justify your results.

Dates of classes: 30.10-03.11.2023.