Institute for Theoretical Physics — Heidelberg University
Prof. Dr. Ulrich Schwarz — Cornelis Mense
Continuum mechanics — Winter term 2025/26

Assignment 1

Handout 22/10 – Return 29/10 – Discussion 05/11

Exercise 1.1 [4 points]: Laplace transform

Calculate the Laplace transform of following functions:

$$\begin{aligned} a) \quad f(t) &= \sin(\omega t) \\ b) \quad f(t) &= \cos(\omega t) \\ c) \quad f(t) &= 4\cos(3t) \\ d) \quad f(t) &= (\sin^2 t)' \end{aligned}$$

Exercise 1.2 [6 points]: Solving ODEs with Laplace transforms

Solve the differential equation

$$\ddot{y} + 9y = \sin(2t)$$

with initial conditions

$$y_0 = 1,\ \dot{y}_0 = -1$$

with two different methods. First use the method of variation of parameters and then redo the calculation using Laplace transforms.

Exercise 1.3 [4 points]: Energy in a Maxwell element

When you pull on a Maxwell element, you need less energy to arrive at a certain extension compared with the case that you pull on a spring, because the dashpot is giving out length. Calculate this energy difference for the case of a constant strain rate r and a pulling time t_1 (in this way, the achieved extension will be the same). Show that this energy difference vanishes if the viscosity C_η is sent to infinity, such that the system becomes purely elastic.