

**Mathematical Modeling  
Contributors**

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## Description

Mathematical modelling is of great importance for solving practical problems by casting them into a form suitable for the use of mathematical techniques. In this course, a number of basic topics are discussed. First, attention is paid to a general methodology by means of the model cycle, which offers a systematic framework for mathematical modelling. Then we focus on some widely used model classes from engineering, in particular on the class of linear time-invariant dynamical models. These are described by linear difference equations (in discrete time) or linear differential equations (in continuous time). Alternative model descriptions that are discussed are transfer functions (in the frequency domain) obtained with the z-transform and the Laplace transform respectively; and state-space models, which may or may not involve canonical forms. Some further topics receiving attention are the concepts of stability, controllability and observability, Bode diagrams, the interconnection of subsystems, and the technique of pole placement by means of state feedback. The subject matter is clarified through exercises and examples involving practical applications. Also, the software package Matlab and the control system toolbox are introduced, which offers a powerful instrument for analyzing linear dynamic models

## Knowledge and understanding

To recognize the various stages one may encounter when setting up and analyzing a mathematical model. Getting acquainted with linear dynamical models and being aware that one may switch between various descriptions of such models and that one may take advantage of this to solve practical problems. Getting used to the concept of 'state', and becoming familiar with linear state-space models.

Being able to set up an elementary mathematical model for several practical problems. Being able to perform elementary model analysis and to switch between various model descriptions to one's advantage.

## Making Judgements

To recognize what are the important aspects to take into account when building a mathematical model. Being able to carry out quickly some basic checks on whether a model makes sense.

## Communication

Being able to interpret model properties from a given model description and to explain this to specialists and non-specialists.

## Skills

Being able to read and interpret basic literature on mathematical modelling. Being prepared for taking subsequent courses on process control and on system identification. Having a basic knowledge of Matlab and some of its toolboxes.