Course Package

Signals, Models & Systems

MODULE 5	1A	15.0 EC
Signals, Models & Systems	First quartile of the first semester	Dr. ir. H. Wormeester

<u>Required preliminary knowledge:</u> LaPlace Transform, Mechanics, Electrical Network Analysis.

This module provides an introduction in the principles of modelling and analysing dynamic systems. A sufficiently realistic description of a (sub-) system is translated to a model that allows a mathematical description in the form of a set of differential equations. The models are based on basic principles like conservation laws and continuity relations. These principles are introduced using a wide range of examples from physics and chemistry, i.e. from different disciplines like dynamics, electrical networks, fluid and heat transport. The ability to probe system dynamics via signal response is elucidated. The description of signals in both time and frequency domain (Fourier Transform) will be used to elucidate mathematical techniques for solving linear differential equations (Eigenvalues, Laplace Transform). The dynamic behaviour of systems is further analysed by simulations and the adequacy of the model description will be discussed. The description and analysis of stochastic signals will be treated. The theoretical description will be facilitated with a few experiments. A set of experimental problems associated to the theoretical Signal & Models have to be solved. These are in the area of 1) system characterization, 2) feedback dynamics and control systems, 3) Modelling of distributed systems and 4) Digital filtering. In the project students have to solve a problem formulated by themselves in the field of signals, models and systems using (part of) the techniques acquired in this course.

Courses in the module:

- Signals & Models
- System Analysis
- Project SMS
- *Elective (1 out of 3)*:
  - *Mechanics of Materials*

(content description is not available yet)

  - *Classical Mechanics*

(content description is not available yet)

  - *Programming and Engineering*

At the end of the course you will have had the satisfying experience of writing small programs to solve some common problems by yourself! You will be able to compose algorithms and develop programs, analyze how much time and space a given algorithm requires understand and modify bigger programs, and "with some practice" you will be able to write efficient programs by yourself. After the course the student is able to...1) write, compile, and execute small programs in MATLAB and C++,2) translate everyday problems into computer-language and develop algorithms for engineering problems,3) "read", understand, modify, and debug in different programming languages, 4) use the advance features of MATLAB including the symbolic tool box, built in ODE solvers and create structure data types.

Computations are omnipresent in complex engineering problems in solid mechanics, fluid mechanics, civil and process engineering. Many problems are resolved with the aid of computers and dedicated programs today. Therefore, it is really important for an engineer to be familiar with computers and programming languages. In this course, you will learn how to translate problems into algorithms and how to implement the algorithm into a computer language. We will focus on implementation in two widely used programming languages: MATLAB and C++. No previous programming knowledge is required. You will learn how to write, compile, and execute small programs in each language. We teach you how to write structured reusable code (object-oriented programming in C++) and how to visualize your solutions (in MATLAB). Further, we teach how to better understand, analyze, optimize, and debug code. The course consists of lectures as well as lots of practical exercises. The course is divided into two sections, C++ and MATLAB. At the end of each section, you will be asked to solve a final assignment (at home), and attend an oral exam.