

## Basics of Control Engineering and Process Engineering (I001973)

**Course size** (nominal values; actual values may depend on programme)

**Credits** 4.0      **Study time** 120 h      **Contact hrs** 45.0 h

**Course offerings and teaching methods in academic year 2017-2018**

A (semester 1)	seminar: coached exercises	11.25 h
	lecture	10.0 h
	seminar: practical PC room classes	12.5 h
	lecture: plenary exercises	6.25 h

**Lecturers in academic year 2017-2018**

Volcke, Eveline	LA05	lecturer-in-charge
Ronsse, Frederik	LA05	co-lecturer

**Offered in the following programmes in 2017-2018**

	crdts	offering
<a href="#">Master of Science in Environmental Sanitation</a>	4	A
<a href="#">International Master of Science in Environmental Technology and Engineering</a>	4	A
<a href="#">International Master of Science in Sustainable and Innovative Natural Resource Management</a>	4	A
<a href="#">Exchange Programme in Bioscience Engineering: Environmental Technology (master's level)</a>	4	A

**Teaching languages**

English

**Keywords**

system dynamics, process control, linear systems  
fluid and gas transport, cooling and heating technology, engine and drive systems

**Position of the course**

The aim of this course is to provide the student a basic education in terms of control engineering and process engineering. Through practical examples, the student is familiarized with the block scheme representation of controlled systems. After imparting the necessary understanding of the dynamic behavior of linear systems, the relationship between open-and closed-loop dynamics is elaborated. Attention is paid to the selection and tuning of controllers. Besides the basic single-loop feedback scheme, cascade control and feedforward control schemes are studied as well. In the field of process engineering the basics regarding the technical aspects of relevant unit operations in mass and energy transfer are detailed. The unit operations include: heating and cooling, transport of liquids and gases, mechanical drive systems.

**Contents**

**Control engineering**

1. Introduction
  - 1.1 Aim of process control
  - 1.2 Terminology
2. Dynamic behaviour of linear systems
  - 2.1 First order systems
  - 2.2 Second order systems
  - 2.3 Higher order systems
3. Feedback control
  - 3.1 Principle - examples
  - 3.2 Controller types

- 3.3 Open-loop versus closed-loop dynamics
- 4. Controller selection and tuning
  - 4.1 Controller design problem
  - 4.2 Performance criteria
  - 4.3 Controller type selection
  - 4.4 Controller tuning
- 5. Cascade control - feedforward control

### **Process engineering**

- 1. Heating and cooling
  - 1.1 Basics of thermodynamic cycles
  - 1.2 Heating technology (steam cycle, heat pumps)
  - 1.3 Cooling technology (reverse Carnot cycle, vapor compression and absorption cooling systems)
- 2. Transport systems
  - 2.1 Liquid transport (hydraulic systems, pumps and valves)
  - 2.2 Gas transport (fans, blowers and compressors)
- 3. Introduction to heat engines
  - 3.1 External combustion engines: Brayton, Sterling and Rankine cycle based
  - 3.2 Internal combustion engines: Diesel & Otto cycle based

### **Initial competences**

Basic knowledge of physical transport phenomena (mass and heat balances)

### **Final competences**

- 1 The student is able to interpret a control problem and to translate it into a block scheme. He knows how to choose an appropriate type of controller and to tune it. He has insight in the dynamics of linear systems, both in open and closed loop.
- 2 The student is capable of interpreting the technical description of an industrial installation (heating and cooling installations, gas and liquid transport systems and thermal engines) and can estimate the requirements which such technical installation has to meet.

### **Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

### **Conditions for exam contract**

This course unit cannot be taken via an exam contract

### **Teaching methods**

Lecture, lecture: plenary exercises, seminar: coached exercises, seminar: practical PC room classes

### **Learning materials and price**

Copies are available estimated total cost: 15 euro. Also electronically available on Minerva

### **References**

Stephanopoulos G. (1984). Chemical process control, an introduction to theory and practice. Prentice-Hall Englewood Cliffs, USA, ISBN 0-13-128629-3

### **Course content-related study coaching**

Student counseling is possible before and after the lectures, during the exercise sessions and by appointment. At the end of the course, a brushup lecture is foreseen.

### **Evaluation methods**

end-of-term evaluation

### **Examination methods in case of periodic evaluation during the first examination period**

Written examination, oral examination

### **Examination methods in case of periodic evaluation during the second examination period**

Written examination, oral examination

### **Examination methods in case of permanent evaluation**

### **Possibilities of retake in case of permanent evaluation**

not applicable

**Calculation of the examination mark**

Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.