GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Process Control (E071170)

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

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	lecture	0.0h
			independent work	0.0h
B (semester 2)	Dutch	Gent		

Lecturers in academic year 2024-2025

Ionescu, Clara	TW08	lecturer-in-charge
Copot, Dana	TW08	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Bridging Programme Master of Science in Chemical Engineering	6	A
Master of Science in Chemical Engineering	6	B
Master of Science in Chemical Engineering	6	A

Teaching languages

English, Dutch

Keywords

Dynamic behavior, digital control systems, system identification, computer assisted design (CAD), PID-autotuning, model based control strategies, multivariable control strategy, control tuning rules, process loop schemes and control structures, process safety, stability, multi-objective performance indicators, mitigating interactions for maintaining process safety and operation

Position of the course

To understand the communication between a computer or decision making system and a physical process
To learn - and to apply - the techniques for modelling and identification of physical systems, starting from measured process signals.
To learn - and to apply - a selection of automatic tuning and of model based control methods which are of high industrial interest within chemical engineering industry
To understand the effect of decision making process onto the safety and operation of multi-loop dynamic processes.
To relate the competences learned in the course within the Industry 4.0 and RAMI 4.0 platforms of process operation.

Contents

- Communication between a computer and a physical process: sampling, discrete-time concepts for control
- Signals from dynamic systems and their models: 1st order, 2nd order, pole-zero transfer functions,
- Impulse response, step response
- First order plus dead time representation of dynamical system
- PID enhancements (e.g. gain scheduling)
- (Auto)Tuning methods for PID controllers from first order plus dead time model approximations
- Process Control Structures: cascade control, ratio control, feedforward control for optimal product specifications fulfillment
- Control loop interaction: RGA analysis

- Loop performance degradation and controller retuning
- Model predictive control: dynamic matrix control
- Process safety and operation in presence of dynamic multi-loop system interactions
- Chemical process control loops and safety

Initial competences

Students successfully passed the course: Signals and systems; Modelling and control of dynamical systems; or have acquired the aspired learning competences in another way - as defined by the curriculum rules of the Faculty of Engineering and Architecture cf. www.ugent.be/ea

Final competences

1 To understand the communication between a computer and a physical process for data acquiring and data sending.
2 To be able to develop a mathematical model formulation through signal processing techniques (first hand approximations, identification methods).
3 To evaluate when model-based and non-model based control should/can be applied.
4 To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations.
5 To have insight into the choice between control strategies and if possible and how to apply them in practice.
6 To identify the interactions between sub-processes and to understand the effect of these multi-level interactions on the operation, stability and safety of the total process.
7 To apply simplifying techniques to complex systems and to analyze the uncertainty introduced by these simplifying assumptions.
8 To be able to communicate and cooperate within a team, to manage a project towards the end objectives and to report the obtained results and evaluate team-work in a critical way.
9 To be able to use software to verify assumptions and results; e.g. for control engineering and automation: Matlab/Simulink.

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

Seminar, Lecture, Independent work

Extra information on the teaching methods

Lecture, independent work, example exercises
blended learning: the online/on campus activities to be determined in agreement with students

Study material

Type: Syllabus

Name: Process Control
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Pages : 200
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

Type: Slides

Name: Process Control Slides
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 500

Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

Students who do not fulfill pre-requisites as indicated please contact the lecturer for an individualised additional material guidance. The list below is generic for all concepts in the course.

- Bequette: "Process Control. Modelling, Design and Simulation" (generic, specific for chemical process
- control)
- Aström and Wittenmark. "Computer Controlled Systems"
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Course content-related study coaching

The lecturer is available during and after the lectures for further explanation; individual explanation and feedback is available on appointment only; feedback is planned within course agenda

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

During examination period: open-book written exam

Calculation of the examination mark

multiple-question exam, evaluation /20 per question, average for final exam mark.