GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2017-2018

Modeling and Control of Waste Water Treatment Plants (I001755)

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

Credits 3.0	Study time 75 h	Contact hrs	30.0 h

Course offerings and teaching methods in academic year 2017-2018

A (semester 1)	English	lecture	12.5 h
		guided self-study	2.5 h
		seminar: practical	15.0 h

Lecturers in academic year 2017-2018

Nopens, Ingmar	LA26	lecturer-in-charge
Amerlinck, Youri	LA26	co-lecturer

Offered in the following programmes in 2017-2018	crdts	offering
Master of Science in Chemical Engineering	3	A
Master of Science in Sustainable Materials Engineering	3	A
Master of Science in Chemical Engineering	3	A
Master of Science in Bioscience Engineering: Environmental Technology	3	A
Exchange Programme in Bioscience Engineering: Environmental Technology (master's level)	3	A

Teaching languages

English

Keywords

Modelling, simulation, model calibration, unit processes, wastewater treatment simulator, benchmarking of control strategies

Position of the course

In this course the wide application of modelling and simulation during the design and optimisation of wastewater treatment plants is taught in a concrete way. The students will be introduced to the stepwise modelling of the different unit processes in these systems and gain insight and practical experience in the model calibration, i.e. fitting industry-standard models such as the Activated Sludge Model No.1 to the reality of a specific treatment plant. A second part of the course deals with the objective evaluation of the economic benefits of the introduction of process control for nutrient removal. Not only is attention given to the process control aspects (monitoring and control equipment, tuning, ...) but also to the evaluation criteria that are needed for a holistic evaluation (effluent quality, biogas production, sludge production, energy consumption). The student learns to use the WEST modelling and simulation software for wastewater treatment systems. Worldwide it is one of the most widespread softwares for dynamic simulation of such systems.

Contents

1. Modelling wastewater treatment plants: introduction
1.1. Historical overview
1.2. Importance of modelling and simulation for design and optimisation (e.g. upgrades) of wastewater treatment plants
2. Stepwise procedure for building simulation models
2.1. Hydraulic characterisation (characterisatie and modelling of mixing)
2.2. Modelling of sedimentation and separation processes (e.g. membranes)
2.3. Modelling biological processes
2.3.1. Stoichiometry
2.3.2. Kinetics

2.3.3. Gujer matrix representation of conversions
2.3.4. Activated Sludge Model nr 1, 2(d) and 3 for COD-, N- and P-removal
2.3.5. Anaerobic Digestion Model nr 1 for sludge digestion
2.4. Calibration procedure
2.4.1. Experimental methods for characterisation of mixing, sedimentation, biological activity (both lab and full-scale methods)
2.4.2. Selection of identifiable parameters (sensitivity analysis)
2.5. Examples of modelled treatment plants with applications in new designs, upgrade-scenarios, optimisation of process operation

3. Benchmarking of process control in wastewater treatment
3.1. Definition of a referencede wastewater treatment plant according to IWA (International Water Association) and EU-COST
3.2. Evaluation procedure for a new proces control loop: important variables, simulation conditions (disturbances, influent characteristics, ...), investment and operating costs, energy consumption, sustainability
3.3. Examples of benchmarking of respirometry-based control strategies, aeration control, stormwater control, nutrient control, ...

Initial competences

Modeling and Control of Waste Water Treatment Plants builds on certain learning outcomes of course unit 'Modelling and Simulation of Biosystems' ; or the learning outcomes have been achieved differently.

Final competences

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

Guided self-study, lecture, seminar: practical PC room classes

Extra information on the teaching methods

Theory: oral lectures
Exercises: exercise sessions and practicals in PC-rooms (WEST) with supervision

Learning materials and price

An English syllabus is available as well as slides of the theoretical and practical classes.

References

Dochain D. and Vanrolleghem P.A. (2001) Dynamical Modelling and Estimation in Wastewater Treatment Processes. IWA Publishing, London, UK. ISBN 1-900222-50-7. pp. 342

Henze, M., Gujer, W., Mino T. and van Loosdrecht, M. (2000) Activated Sludge Models ASM1, ASM2, ASM2D and ASM3. Scientific and Technical Report No. 9, IWA Publishing, London

Course content-related study coaching

Study coaching is offered before and after each of the theory lectures and practicals.

Evaluation methods

end-of-term evaluation

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

Written examination, open book examination, simulation

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

Written examination, open book examination, simulation

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Exercises: period aligned evaluation
Students who eschew period aligned and/or non-period aligned evaluations for this

course unit may be failed by the examiner.
Exercises: written examination
During the examination concerning the practicals, it will be evaluated if a student can solve a practical problem using the acquired methods in a simulation environment and use this to answer questions about a system.
Students who eschew periodic evaluations for this course unit may be failed by the examiner.

Calculation of the examination mark

Exercises: 100%