

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

Credits 5.0 Study time 150 h Contact hrs 50.0 h

Course offerings and teaching methods in academic year 2019-2020

A (semester 2) English lecture 50.0 h

Lecturers in academic year 2019-2020

Rabaey, Korneel LA25 lecturer-in-charge
Zhuiykov, Serge KR01 co-lecturer

Offered in the following programmes in 2019-2020

[Bachelor of Science in Environmental Technology](#) crdts 5 offering A

Teaching languages

English

Keywords

Wastewater treatment, drinking water, environmental biotechnology, water quality

Position of the course

This course presents an engineering based approach towards sanitation processes based on microbial conversions as well as physico-chemical processes. These conversions are the foundation of a wide variety of environmental technical constructions. The course mainly deals with wastewater treatment, but also to a lesser extent discusses drinking water preparation. Not only conventional activated sludge is discussed, we also highlight novel technological solutions such as membrane bioreactors. The practical exercises consist of design calculations and process measurements in the context of a case study. Laboratory exercises focused on the *hands-on* experience of measurement various water contaminants.

Contents

Section Biotechnological processes discusses the key aspects of the activated sludge process. This is then extended with new or other types of treatment systems including membrane bioreactors and biofilm based systems. Finally, biological aspects of drinking water production, such as slow sand filtration, are highlighted.

1	Wastewater treatment	11
2	Activated sludge	14
3	Special types of activated sludge processes	82
4	Membrane bioreactors	87
5	Biofilm based wastewater treatment	99
6	Resource recovery from wastewater	118
7	Biological aspects of drinking water production	128

This section is complemented with theoretical exercises, in which the different unit processes for wastewater treatment are calculated through, ending with the design of a complete wastewater treatment plant.

Section Physico-chemical processes focuses on different aspects of physico-chemical water treatment, including sedimentation, coagulation and flocculation, aeration and filtration. Various design aspects of these processes are discussed. Finally, state-of-the-art water quality sensors are considered in details.

1. Physico-chemical wastewater treatment plant
2. Sedimentation
3. Coagulation and Flocculation

4. **Aeration**
5. **Filtration and filtration by powdered activated carbon**
6. **Water quality sensors**

Physico-chemical section is completed with theoretical and designs examples, in which modern approaches are presented. Laboratory practical exercises invigorated the theoretical knowledge obtained.

Initial competences

Students need to have followed:

Environmental Chemistry, Biochemistry, Physics 1, 2, 3 and 4, Microbiology

Final competences

- 1 1 Capacity to evaluate the biotechnology of clean water production and of aerobic waste treatment.
- 2 2 Capable to comprehend the engineering principles of the processes covered in the course.
- 3 3 Be able to design the important biotechnological unit processes.
- 4 4 Have the attitude to judge the various processes in terms of performance and order of magnitude of overall opex and capex.
- 5 5 Capacity of evaluate main approaches for design of the modern wastewater treatment plant for non-bio-degradable waste and its main parts.
- 6 6 Have a knowledge about main process of the wastewater plant and modern trends in development water quality measuring instruments.
- 7 7 Have insight and deep knowledge with regard to modern physical and chemical wastewater treatment.
- 8 8 Have insight in the latest development of water quality sensors.

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises

Extra information on the teaching methods

Theory and theoretical exercises for section biotechnology are provided as lectures.

Learning materials and price

Course notes are provided via pdf, accessible on Minerva

References

Environmental Biotechnology – Principles and Applications. (B.E. Rittmann & P.L. McCarty, Eds.). McGraw-Hill International Editions, Biological Sciences Series, 754 p. ISBN 0-07-118184-9
 W. Verstraete and E. Van Vaerenbergh. 1986. Aerobic activated sludge, p. 44 112. Chapter 2. In : Biotechnology Vol. 8. H.J. Rehm and G. Reed (Eds.). VCH Verlagsgesellschaft, Weinheim

Course content-related study coaching

Evaluation methods

end-of-term evaluation

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

Written examination with open questions, open book examination

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

Written examination with open questions, open book examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Section biotechnology: several reasonably brief questions spanning the course, as well as one or two longer, open questions aimed to examine general understanding of technological concepts

Calculation of the examination mark

Part biotechnological processes 12/20 from which 3 credits exercises
Part physicochemical processes 8/20