GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Soil Physics (I002657)

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

Credits 5.0 **Study time 150 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	English	Gent	practical seminar lecture

Lecturers in academic year 2025-2026

Cornelis, Wim	LA20	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Master of Science in Sustainable Land Management(main subject Land and Groundwater Management)	5	A
International Master of Science in Soils and Global Change (main subject Physical Land Resources and Global Change)	5	A
International Master of Science in Soils and Global Change (main subject Soil Biogeochemistry and Global Change)	5	A
International Master of Science in Soils and Global Change (main subject Soil Ecosystem Services and Global Change)	5	A
International Master of Science in Soils and Global Change (main subject Soil-Plant System Processes and Global Change)	5	A
Master of Science in Sustainable Land Management(main subject Urban Land Engineering)	5	A
Master of Science in Bioscience Engineering: Land, Water and Climate	5	A
Exchange Programme in Bioscience Engineering: Agricultural Sciences (master's level)	5	A
Exchange Programme in Bioscience Engineering: Environmental Technology (master's level)	5	A
Exchange Programme in Bioscience Engineering: Land and Forest management (master's level)	5	A

Teaching languages

English

Keywords

soil-water content, soil-water potential, water retention, soil-flow of water and chemicals in soils, soil structure

Position of the course

Soils constitute a central link between air, ground and surface water, and living organisms and are thus crucial to ecosystem functioning. This basic course aims at providing profound knowledge on and insights in physical properties and processes of and in soil, and how to measure and model them, applying physical and mathematical laws. Soil-water relationships are central to the course. A profound understanding of soil physical properties and processes is essential in studies on water and chemical transport in soils, irrigation and drainage, biomass production, trafficability, gas emission from soils, soil erosion, soil compaction, salinization and ecosystem functioning, among others.

Contents

Concepts and principles

1. Introduction to soil physics

Part 1. Soil solid phase

2. Composite soil properties
3. Soil structure
Part 2. Water retention in soils
4. Properties of water related to porous media
5. Soil-water content
6. Energy status of water in soil
7. Water retention curve
Part 3. Water movement in soil
8. Water flow in capillary tubes
9. Water flow in saturated soil
10. Water flow in unsaturated soil
Part 4. Chemical transport in soil
11. Conservation and flux equations
12. Convection-dispersion equation

Measuring and modeling in practice

During lab and field work, intact soil samples are taken from fields with different land use, and soil physical and hydraulic properties are measured. At the field, water content and matric potential is measured. Data are used to assess the effect of land use on 1) soil health using soil physical quality indicators and 2) on the water regime with the Hydrus model.

Initial competences

The student should have good knowledge of mathematics and physics, and some basic understanding of earth sciences and soil science or pedology.

Final competences

1 Apply standard lab and field methods to determine hydrophysical properties of soil.
2 Use soil-moisture sensors and tensiometers to measure soil-moisture status.
3 Explain the principles behind lab and field methods, and instrumentation for monitoring soil-moisture status.
4 Analyse simple to more complex water transport processes in soil.
5 Evaluate physical quality of soils.
6 Apply parameter estimation methods to determine soil hydraulic properties.
7 Apply numerical models to predict changes in water content and matric potential with time.
8 Explain hydrophysical and soil mechanical properties of soil.
9 Explain the principles behind water and chemical transport in soil.

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

Group work, Seminar, Lecture, Practical

Extra information on the teaching methods

Lecture: online lectures (short videos) in preparation of on campus seminars and practicals.

Excursion: Fieldwork (at the Bottelaere experimental farm and on campus) on soil sampling and measurement of 1. soil structural quality with visual evaluation methods, 2. soil-moisture status with sensors and tensiometers, 3. hydraulic conductivity and infiltration rate.
Practical: Laboratory work on measuring bulk density and porosity, water content (gravimetrically), water retention curve, hydraulic conductivity curve.
Seminar: active hands-on teaching on case studies with quizzes to link theory to practice, on parameterisation of the water retention curve, and on simulating the effects of land use and soil structural degradion on soil-water dynamics with the Hydrus model, using data collected during practical.
Group work: results from the seminars on parameterisation of the water retention curve, and on simulating the effects of land use and soil structural degradation on soil-water dynamics have to be shared and prepared for oral discussion.

Study material

Type: Syllabus

Name: Soil Physics. Lecture notes and exercises
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Pages : 368
Oldest Usable Edition : 2024-2025
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

Jury, W.A. & Horton, R. 2004. Soil Physics. John Wiley & Sons.
Hillel, D. 1998. Environmental Soil Physics : Fundamentals, Applications, and Environmental Considerations. Academic Press.
Radcliffe, D.E. & Simunek, J. 2010. Soil Physics with HYDRUS: Modeling and Applications. CRC Press, Taylor & Francis Group

Course content-related study coaching

Instructors (professor/assistants) are available for questions and further explanations on appointment.

Assessment moments

end-of-term and continuous 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

Oral assessment, Participation, Written assessment open-book

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

Written assessment with open-ended questions (periodic evaluation): short answer and essay questions on theory + exercises. This evaluates the teaching methods lecture and seminar.
Written assessment open-book (permanent evaluation): assessment of the quizzes related to seminars and practicals. This evaluates the teaching methods seminar and practical.
Participation (permanent evaluation): assessment of participation in quizzes related to seminars and practicals. This evaluates the teaching methods seminar and practical.
Oral assessment (permanent evaluation): assessment of the parameterisation and modeling exercise related to seminars and practicals. This evaluates the teaching methods seminar and practical.

Calculation of the examination mark

Written assessment with open-ended questions(periodic evaluation): 65%
Written assessment open-book, oral assessment, participation (permanent evaluation): 35%
Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner. This means that if, in that case, a grade of 10 or more out of 20 is obtained, the grade may be brought down to 7/20.