GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

3D Digital Rocks (C003727)

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

Credits 3.0 **Study time 88 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	practical seminar lecture

Lecturers in academic year 2024-2025

Bultreys, Tom	WE13	lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Master of Science in Geology	3	A
Exchange programme in Geology (master's level)	3	A

Teaching languages

English

Keywords

3D data on pore structures, fluid flow behaviour on the microscopic pore scale, simulations of fluids inside porous rocks, material and dynamic properties

Position of the course

Understanding how fluids occupy and migrate through porous media is of great importance in many geological fields like hydrologeology, environmental engineering and subsurface storage of hydrogen and carbon dioxide. The search to better understand the inner workings of rocks that challenge traditional laboratory testing has led to a new approach known as digital rock physics. 3D images (deriving from X-ray CT data, FIB/SEM data, synthetic 3D images of rocks based on information obtained from 2D microscopy techniques) can be used as an input to compute dynamic material properties (including fluid flow behavior). Using digital techniques such as pore network modelling or Lattice Boltzmann modelling, fluid flow behaviour can be modelled and studied.

Contents

- Introduction to digital rocks
- Creating virtual rock models based on 2D images
- Creating a 3D pore network
- Introduction towards the relation between sample size versus resolution versus scale issues
- Analysing 3D pore networks
- Simulation of fluid flow in pore networks and determining associated material properties
- Overview of validation techniques

Initial competences

Bachelor geology: the student has a basic knowledge in geology, sedimentology, mineralogy, petrology and optical mineralogy & petrography + attended the course “Rock imaging techniques”

Final competences

1 Understanding the concepts and processes occurring when creating underlying 3D pore models of fluid flow in porous rocks
2 Identifying strengths and weaknesses of pore-scale models for groundwater and geo-energy applications
3 Developing a research plan to characterise the fluid flow behaviour of porous rocks.
4 Critically reporting the results of the simulations and laboratory validation data.

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, Practical

Study material

Type: Slides

Name: Slides provided by the lecturer
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 407
Oldest Usable Edition : 2022
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

Blunt, M.J. 2017. Multiphase Flow in Permeable Media: A Pore-Scale Perspective (1st edition)
Russ, J.C., 2011. The Image Processing Handbook, Sixth Edition
Brandon D., Kaplan, W., 2008. Microstructural Characterization of Materials

Course content-related study coaching

Theory: interaction during lectures. Possibility to ask lecturer questions in person and by e-mail
Practice and seminars: guidance and feed-back during the practice and seminars.
Interactive support by Ufora (emails)
Personal contact after appointment

Assessment moments

end-of-term and continuous assessment

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

Written assessment

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

Written assessment

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

not applicable

Calculation of the examination mark

Written examination with open questions: 80%
Assignment + participation in practical sessions: 20%