GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Applied Geophysics and Rock Physics (I003020)

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

Credits 15.0 **Study time 450 h**

Course offerings in academic year 2026-2027

A (semester 1) English Gent

Lecturers in academic year 2026-2027

Malehmir, Alireza	UPPSALO1	lecturer-in-charge
Almqvist, Bjarne	UPPSALO1	co-lecturer

Offered in the following programmes in 2026-2027	**crdts**	**offering**
International Master of Science in Sustainable and Innovative Natural Resource Management	15	A

Teaching languages

English

Keywords

Position of the course

This is an introductory course in applied geophysical methods and rock physics for students with a solid geology/earth science or math and physics background. The course gives an introduction to geophysical prospecting techniques, processing, modelling and interpretation of geophysical data and the physical properties of rocks and soils. Lectures and field components are partly shared with the course Applied and environmental geophysics.

Contents

The course is divided into geophysical field methods and measurements of physical properties (rock physics).
Geophysical field methods: Seismic reflection method, seismic refraction method, gravity measurements, magnetization and magnetic field measurements, electrical methods, electromagnetic methods including georadar, radiometric methods, borehole logging, geophysical field techniques, modelling and interpretation of geophysical data, field course. The following physical principles are addressed: gravity including Newton's law; magnetic fields including Biot-Savart's law, induced and remanent magnetization; seismic wave propagation including Huygens principle, reflection and refraction; static electric fields including Ohm's law, current flow in homogeneous and inhomogeneous media and refraction; electromagnetism including Maxwell's equations, induction processes and primary and secondary fields; natural radioactivity including decay and radiation.
Physical properties (rock physics): introduction to properties and measurements of density, porosity, permeability, elastic and inelastic properties, seismic properties, magnetism, electrical conductivity, and the influence of pressure and temperature on these properties. The following physical principles are addressed: lithostatic and hydrostatic pressure and the connection to porosity, density and permeability; mechanisms of electric current flow (including Ohm's law) and their dependence on pressure and temperature, relation between electrical and hydrological current flow; transport of heat by advection, conduction and diffusion; seismic and (in) elastic properties described by Hooke's law, stress, strain and stiffness, and how seismic properties are affected by pressure and temperature; the foundation of magnetism in quantum physics, various types of magnetism including Larmor precession and Curie's law, mechanisms behind remanent magnetization;

principles used in various laboratory instruments.

Initial competences

120 credits including (1) 60 credits in mathematics and physics or (2) 60 credits in earth science and 15 credits in mathematics. Proficiency in English equivalent to the Swedish upper secondary course English 6.

Final competences

1 On completion of the course, the student should be able to:
- Analyse the physical principles of seismic wave propagation, describe and apply the principles of seismic data collection and have an overall understanding of the measuring instruments used,

2 • Reflect over the main steps in processing seismic reflection and refraction data and interpret seismic sections and models,

3 • Perform gravity measurements, calculate the free-air and Bouguer anomalies and interpret gravity data,

4 • Compare the most common forms of magnetization, explain how proton and optically pumped caesium magnetometers work and interpret magnetic data,

5 • Evaluate the physical principles behind different electrical and electromagnetic methods and how they are applied to determine the electrical conductivity and dielectric permittivity of the ground,

6 • Compare different geophysical methods, analyse their weaknesses, strengths and usefulness for different applications in different environments, such as exploration for groundwater, mineral resources and geothermal energy, monitoring of contamination in aquifers, evaluation of landslide hazards, etc,

7 • Describe and compare physical properties (petrophysics) of different minerals and rocks, with a focus on measurements of these properties,

8 • Interpret and compare petrophysical data on different measurement scales (from e.g. laboratory, field and borehole measurements),

9 • Evaluate which geophysical methods and laboratory methods are suitable to use when a given rock type is to be explored or investigated and design measurements using these methods.

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

Seminar, Excursion, Lecture, Practical

Extra information on the teaching methods

The course consists of lectures, seminars, exercises, laboratory work and a compulsory field course. Participation in laboratory work, field course and associated lectures is mandatory.

Study material

None

References

- Reynolds, John M., An introduction to applied and environmental geophysics, 2. ed., Wiley, 2011 * Compulsory*

Course content-related study coaching

Assessment moments

end-of-term assessment

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

Written assessment, Assignment

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

Written assessment, Assignment

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

Geophysical field methods: Written exam (5 credits), field course including written report and homework assignments (5 credits). Rock physics: Homework assignments (3 credits), report on rock physics laboratory work (2 credits).
If there are special reasons for doing so, an examiner may make an exception from the method of assessment indicated and allow a student to be assessed by another method. An example of special reasons might be a certificate regarding special pedagogical support from the disability coordinator of the university.

Calculation of the examination mark