GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Physics 3 (C000248)

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 2)	Dutch	Gent	seminar
			lecture
			practical

Lecturers in academic year 2025-2026

Cottenier, Stefaan	TW08	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Geology	5	A

Teaching languages

Dutch

Keywords

Electricity, magnetism, electromagnetic oscillations, waves and radition

Position of the course

This course constitutes the third part of general, fundamental physics in the "classical" domain that consists of three major, all-semester courses: I. Mechanics, II. Waves and Optics and Thermal Physics, and III. Electromagnetism (incl. relevant aspects of Modern Physics). The objective of this third part is to gradually develop the theory of electromagnetism in a "soft" mathematical framework and emanating from the very initial experiments in the domain of electrostatics on the one hand, and those in the area of magnetism on the other hand. This approach finally results in the four fundamental laws of Maxwell that govern all electromagnetic phenomena that are known to date. Numerous relevant examples of these phenomena are presented, discussed and explained, commonly on the basis of elementary mathematics. The paramount importance from the point of view of scientific education and training, is that the student, by this logical and deductive approach, learns how a completely developed domain in natural sciences gradually evolves from basic experiments that lead to fundamental laws. As in Physics 1 and Physics 2, the essential role played by basic calculus in the whole of this process is highlighted. The aim of the *lab* tasks (where *lab* is used in a broad way), which is an integrated part of Physics 3, is to enlarge the observational and experimental skills of the student, as well as the critical interpretation of results.

Contents

- Electric charge, conductors, electric force, electric field (laws of Coulomb and Gauss).
- Electric potential (point charges, continuous charge distributions).
- Capacitors (capacitance, circuits, energy, dielectrics).
- Electric current (resistance and resistivity, Ohm's law), Electric circuits (electromotoric force, resitors in circuits, RC circuit, electric power).
- Magnetic fields, magnetic forces on moving charges and currents, geomagnetic field, discovery of the electron (Thomson's and Millikan's experiments), Hall effect, cyclotron, torque on a current loop, solenoid, magnetic dipole.
- Magnetic fields due to currents, laws of Biot-Savart and Ampère, solenoid, magnetic dipole moment.
- Induction (laws of Faraday and Lenz) and self-induction, RL circuit, magnetic

energy, Maxwell's laws
- Magnetism of matter (electrons, atoms, condensed matter, magnetic orderings).
- Electromagnetic oscillations (LC circuit, RLC circuit, damped and forced oscillations, resonance), alternating currents, power of alternating currents.
- Electromagnetic waves, modern measurement techniques based on electromagnetic radiation, energy transport, polarisation.
- Some aspects of Modern Physics: wave-particle duality (photoelectric effect, Compton scattering), stimulated emission (the laser), uncertainty principle of Heisenberg, the wave function.

Initial competences

Students taking this course have experienced a sufficient pre-education in the preceding courses Physics 1 and Physics 2. Their knowledge of basic mathematics (trigonometry and calculus) is adequate for the understanding of the mathematical approaches that are involved in the Electromagnetism course.

Final competences

1 Gain insight into the physical laws describing electromagnetic phenomena and validate these with examples.
2 Draw connections between topics in this course and the courses Physics I and Physics II.
3 Understand the mathematical derivation and/or formulation of physics principles in this course. Be able to describe these mathematical descriptions accurately and to apply them in examples from geology (soil sciences, mineralogy, ...).
4 Cary out physics experiments independently, correctly interpret the observations and report them clearly.
5 Analyze simple physics problems and translate then to a mathematical context to obtain a solution.
6 Estimate orders of magnitude of physical quantities.
7 Judge outcomes of calculations and experiments by making an educated guess of the expected result.

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, Independent work

Extra information on the teaching methods

The course content -- theory as well as exercises -- gets acquired via a combination of specific self-study tasks followed by collective feedback (response college), possibly supplemented by lectures and/or exercise session when useful or needed.
The experimental assignments ('practica') are done partly individually and partly as a member of a team, usually in the daily life context.

Study material

Type: Handbook

Name: Natuurkunde Deel 2 - Elektriciteit, magnetisme, optica en moderne fysica - D.C. Giancoli'
Indicative price: € 75
Optional: no
Additional information: Same book as Physics II, an English version exists

Type: Handouts

Name: Learning material'
Indicative price: Free or paid by faculty
Optional: no
Additional information: Ufora is the central hub for access to : the self-study tasks supporting texts and videos recorded lectures and feedback sessions lab assignments and reports

References

- sections of "The Feynman Lectures on Physics, vol. II" (free online version)
- lectures by Walter Lewin (MIT Physics II: Electricity and Magnetism)

- Flipping Physics, in particular the Electricity and Magnetism review.
- D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, 6th Ed., Wiley & Sons (2001).
- H. Young, R. Freedman, University Physics, 11th Ed., Addison Wesley (2004).

Course content-related study coaching

The content of this course is available at many places and in many different forms. Explaining the same content once again has therefore limited added value. Therefore, focus is in the first place on feedback, collectively as well as individually. The feedback helps every student to overcome their specific problems, after which they can continue independently again.

Assessment moments

end-of-term and continuous assessment

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

Written assessment with multiple-choice questions, Written assessment with open-ended questions

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

Written assessment with multiple-choice questions, Written assessment with open-ended questions

Examination methods in case of permanent assessment

Skills test, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

Evaluation for theory and problem-solving at the end of semester to probe the students' knowledge and insight and the ability to apply the basic laws of electromagnetism to practical problems.

- Theory: multiple choice and/or open questions to evaluate understanding and knowledge of the subjects presented in the course, with emphasis on those aspects that are relevant to future studies in the field. This exam focuses on insight and understanding, less on reproduction of knowledge. The students are allowed to use a compendium of physics equations provided on Ufora.
- Problem solving: written exam, to examine the ability of the student to solve physical problems. (some exercises will be presented at the exam) The students are again allowed to use the aforementioned compendium provided on Ufora.

Permanent evaluation on

- the effort spent to the self-study tasks, both for the theory and the exercises (the effort, not the correctness - making mistakes is allowed).
- the experimental exercises after each session on the basis of the submitted report, taking into account planning, experimental skill and the ability to critically interpret and report scientific results.

Calculation of the examination mark

Permanent evaluation (30%, is transferable to the second exam period) + periodical evaluation (30% theory, 40% exercises). Students who do not fulfill the requirements of permanent evaluation, by not doing the self-study tasks or by not doing them in time, by not attending the laboratory exercises or by not submitting their reports, cannot pass this course. In case of a legitimate absence, you will need to catch up with these activities (to be discussed on a case-by-case basis). The contribution by permanent evaluation will be added to the total grade only for those who achieve at least 45% for the periodical evaluation. If that threshold has not been reached, the final result will be determined only by the periodical evaluation (example: 6/6 for permanent evaluation and 6/14 (=43%) for periodical evaluation does not sum to 6+6=12/20, yet to 9/20).

Facilities for Working Students

All course materials are provided in a digital way (as well). Lectures and feedback sessions are recorded, and are livestreamed whenever technically feasible. Most activities can be done in place-independent and time-independent way.