

# Course Specifications

Valid as from the academic year 2025-2026

# Electricity, Magnetism and Sensors (1002429)

Course size	(nominal values; actual values may depend on programme)				
Credits 5.0	Study time 150 h				
Course offerings and t	teaching methods in academic ye	ar 2025-2026			
A (semester 1)	Dutch	Gent	lecture		
		seminar			
Lecturers in academic	year 2025-2026				
Verstraelen, Toon			WE05	lecturer-in-charge	
Offered in the following programmes in 2025-2026				crdts	offering
Bachelor of Science in Bioscience Engineering				5	А

#### Teaching languages

Dutch

#### Keywords

Basic physics, electricity, magnetism, electromagnetic waves, light, sensors

#### Position of the course

The objective of the course is for students to obtain a solid basic knowledge and basic insights in electricity, magnetism and physical optics, in which their use in sensors is explained. Basic aspects with respect to measuring with sensors (precision, accuracy, analog-digital conversion,...) is also taught.

#### Contents

1. Introduction to measuring with sensors (measurement range of a sensor, accuracy, precision, resolution, linearity, hysteresis, saturation, amplification of signals, causes and impact of noise on measurements, bandwidth, analog/digital conversion)

 2. Electrostatics: electric charge (conservation law, conductor, isolator, induction), Coulomb's law, electric field, Gauss's law, electric potential, electric dipole.
 3. Capacitors: capacitance, dielectrics, electric energy storage (application: capacitive sensors for measuring pressure, sound, air humidity, super capacitors, primary and secondary batteries)

4. Direct current circuits: electric current, resistance, Ohm's law, non-Ohmic resistors, diode, specific resistance, temperature dependence of resistors, series and parallel circuits, Kirchhoff's laws, RC circuit (application: measurement of forces using a strain gauge, measurement of fluid speed using a hot-wire anemometer, measurement of humidity of air/soil/material using resistive sensors, temperature measurement using temperature sensitive resistors)

5. Magnetism: magnetic field, force on a conducting wire and a moving charge, permanent magnets, fields generated by direct currents (laws of Ampère's law and Biot-Savart), magnetic dipole, solenoid, electromagnet, Hall effect (application: measurement of displacement/rotation using a Hall effect sensor)

6. Electromagnetic induction: laws of Faraday and Lenz, self induction and mutual induction, electromagnetic oscillations, introduction to alternating current circuits, transformer, impedance matching (application: measurement of displacement using a LVDT, Induction motor and generator, synchronous generator, rectifier)
7. Thermoelectric and piezoelectric effect (application: piezoelectric sensors for measuring accelerations, forces and pressures (including sound), measurement of temperature using a thermocouple)

8. Maxwell's equations: Ampère's circuital law, Gauss's law for magnetism,

electromagnetic waves, energy transport, the Poynting vector, electromagnetic spectrum, absorption of light (Lambert-Beer)

#### Initial competences

This course builds on certain final competences of "Analysis: Functions of One Variable" (1002907), "Linear Algebra" (1002909), "Analysis: Functions of Several Variables" (1002910), and "Mechanics, Vibrations and Waves" (1002417); or equivalent competences acquired by other means.

#### **Final competences**

1 Be able to describe and analyze electrical and magnetic phenomena.

- 2 Be able to use and apply the various physical laws of electricity and magnetism.
- 3 Understand the operation of sensors based on electrical, magnetic or electromagnetic principles.

#### 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

#### Extra information on the teaching methods

Plenary lectures for the theory part of the course. Exercise sessions consist of guided problem solving related to the theory and with a focus on applications of the theory.

#### Study material

Type: Handbook

Name: Elektriciteit, magnetisme en sensoren (a selection of chapters from Natuurkunde deel 2, only available in Dutch) Indicative price: € 68 Optional: no Language : Dutch Author : Douglas G. Giancoli ISBN: 978-9-04304-324-3 Number of Pages : 450 Oldest Usable Edition : 4 Online Available : No Available through Student Association : Yes Usability and Lifetime within the Course Unit : intensive Usability and Lifetime within the Study Programme : one-time Usability and Lifetime after the Study Programme : occasionally Additional information: The textbook is custom-made incorporating only relevant chapters for the subject to reduce cost. It is only available in Dutch. ISBN and number of pages are not yet known before the deadline for the course specification. This information will be shared with the student body in order to purchase the book in bulk at a favorable price.

#### References

See learning materials.

#### Course content-related study coaching

Guided problem solving. Possibility to ask questions before and after the theory lectures and online.

#### 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

### Possibilities of retake in case of permanent assessment

not applicable

#### Extra information on the examination methods

Periodical evaluation: written exam (closed book) consisting of multiple-choice questions and open questions (theory questions and exercises).

## Calculation of the examination mark

Periodical evaluation: exam, 100% of the total mark.

# Facilities for Working Students

no extra facilities