

Scientific Thinking (E075080)

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

Credits 3.0

Study time 90 h

Course offerings in academic year 2023-2024

A (semester 2)	English	Gent
B (semester 1)	English	Gent

Lecturers in academic year 2023-2024

Lefevere, Merel	LW01	staff member
Zahidi, Karim	LW01	lecturer-in-charge
Van Langenhove, Lieva	TW11	co-lecturer

Offered in the following programmes in 2023-2024

	crdts	offering
International Master of Science in Textile Engineering	3	A, B

Teaching languages

English

Keywords

Scientific thinking, critical thinking, scientific integrity, research methodology, statistical methods.

Position of the course

Scientific thinking and acting is crucial for conducting sound research. Critical thinking in the broad sense is one of the strategic objectives of Ghent University. Intelligence and an academic education are not enough to prevent irrational thinking. Critical thinking does not develop spontaneously but must be learned. Today, in the age of information, it is more important than ever to be able to estimate the reliability in the oversupply of information and to use scientifically sound methods for this. The multicultural society and globalization also increase the need for critical thinking. How can we critically assess our own cultural traditions (beliefs, attitudes, customs) and those of others, and how do we deal with cultural diversity? Engineers have acquired a thorough scientific basis, but they too are not free from irrational thinking. This course focuses primarily on international groups of engineering students.

Contents

The aim of this course is to teach the students to think and act in a scientific and critical way, also outside their academic field of expertise. We start with theoretical introductory lessons, in which the principles of critical thinking are introduced and the various pitfalls of the human brain are explored. The students learn from examples why we are susceptible to irrational beliefs, and how intelligent people can make mistakes. Then they learn to apply the principles within the field and beyond in daily life. Techniques from statistics, logics, argumentation theory and probability theory are provided to support the thinking processes. Students learn to reflect on the fallibility of the human brain, acknowledging their own ignorance, and the importance of openness of mind.

Introduction lessons

The aspects that are covered in the introduction lessons are:

- critical thinking:
 - definition and relevance
 - basic principles and rules of thumb
 - thinking errors and other mechanisms that form the basis of erroneous views: the limitations of intuition and memory, heuristics, thinking patterns, group pressure, cognitive

- dissonance, confirmation bias
- characteristics / recognition of unreliable information and influencing
- the correct assessment of social sources of knowledge (authority, expertise)
- recognizing the importance and application of scientific methods
- self-reflection, acknowledgement of ignorance and the creation of an openness of mind
- the willingness to revise opinions in the light of new arguments and evidence
- examples from the field, personal experiences and current events
- statistical methods:
 - The world is not dependent on the way we look at it, but how we see the world is: concepts such as population, tests at random, estimates, distribution, probability, reliability, bias
 - statistical tests
 - efficient design of experiments
- argumentation skills
 - the most important forms of argument and logical principles
 - common fallacies and thinking errors
- application to scientific integrity: definition and aspects of careful, reliable, verifiable, impartial and independent conduct of research

Group work

Students reflect in groups on the topics that were introduced and apply the learned principles.

Project

Students reflect on the topics that were introduced in the lectures or through guided self-study, and provide examples in which they apply the theory of these topics.

Initial competences

Basic knowledge of engineering sciences

Final competences

- 1 acquire knowledge about the basic principles of critical thinking and the pitfalls of human thinking
- 2 acquire knowledge of statistical techniques, argument forms and probability theory to support correct reasoning
- 3 be able to apply the acquired knowledge and insights in critical and scientific thinking in professional and daily situations
- 4 intercultural thinking: the capacity to think critically about one's own cultural traditions and those of others

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, Independent work

Learning materials and price

Learning material is offered through UFORA

References

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

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

Assignment

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

Assignment

Examination methods in case of permanent assessment

Professional practice, Participation, Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

(Approved)

Extra information on the examination methods

- NPE: the main focus is on the active participation and critical sense of the student to function optimally in an international and multicultural team.
- PE_A1: final presentation, report

Calculation of the examination mark

- NPE: 60%.
- PE_A1: 40%